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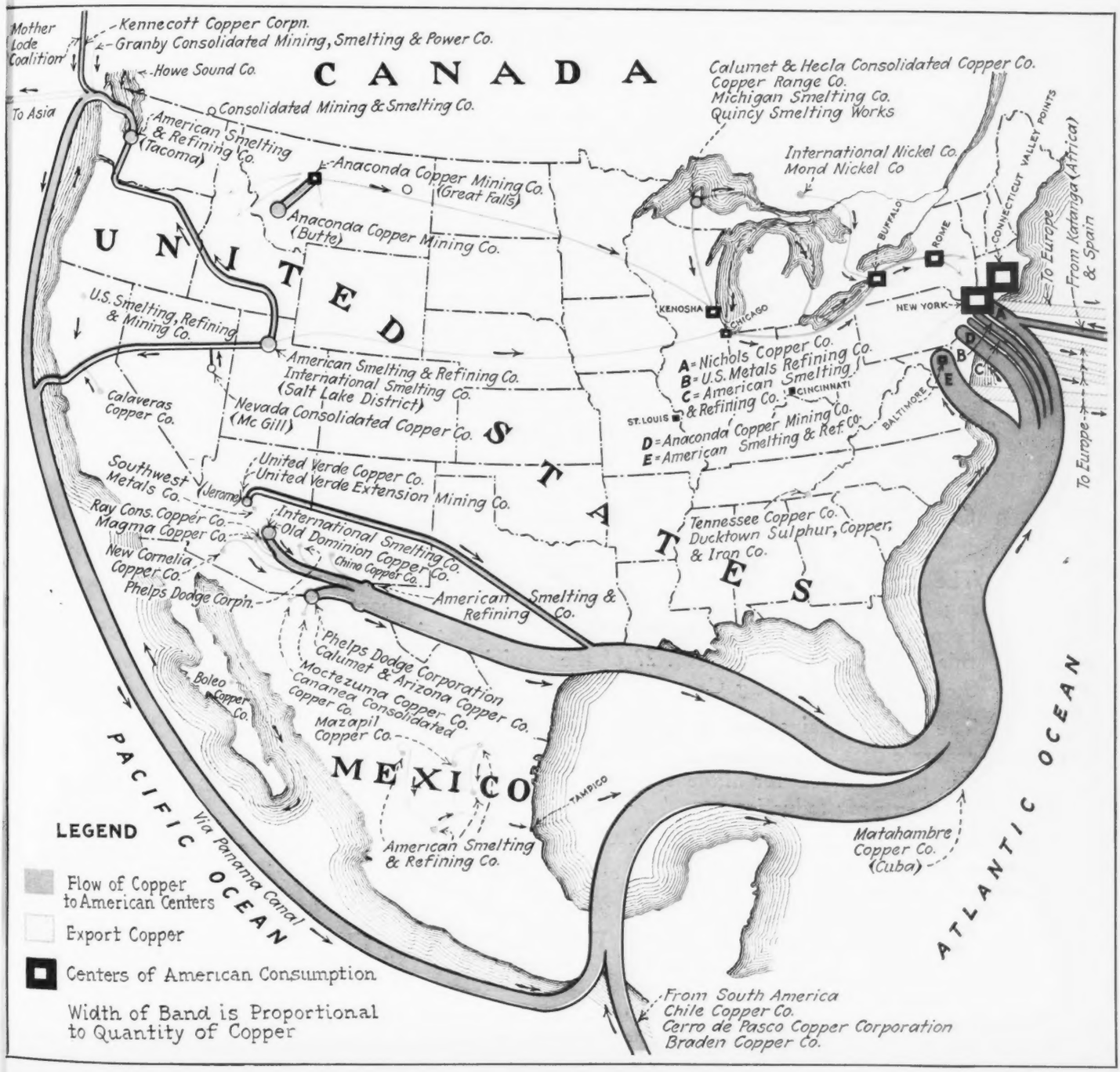
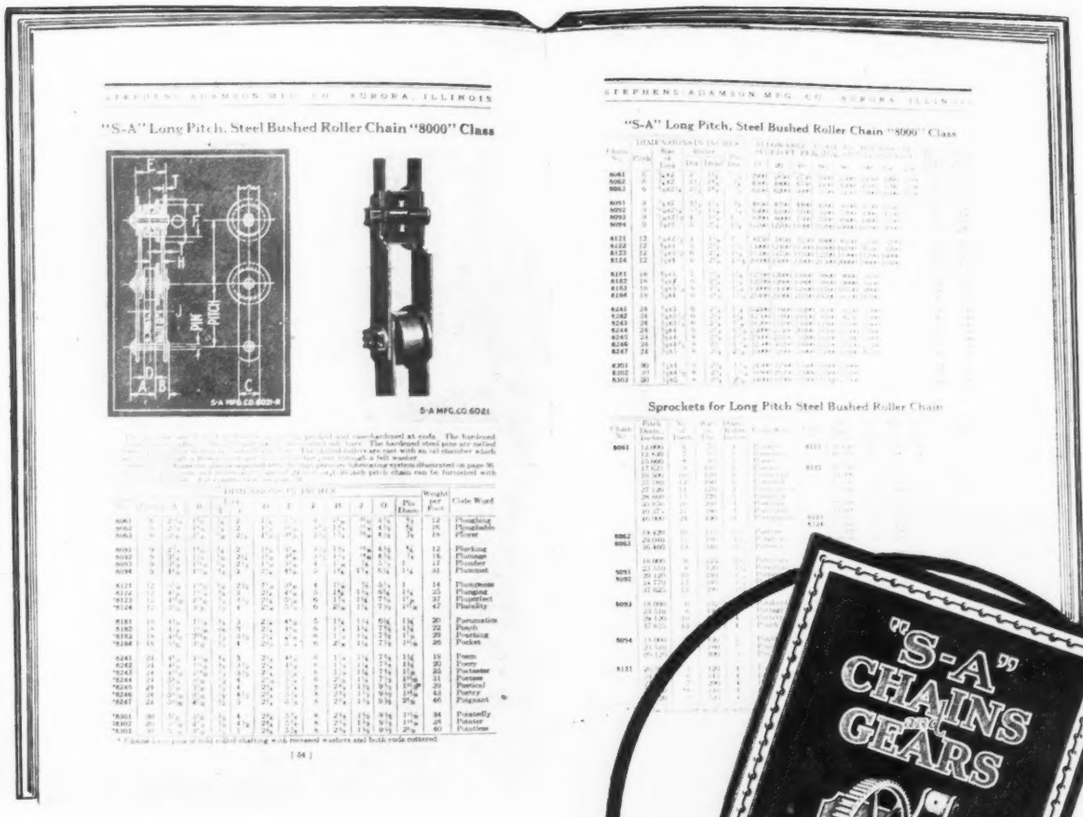


F. E. Wormser, 1925

Flow of American Copper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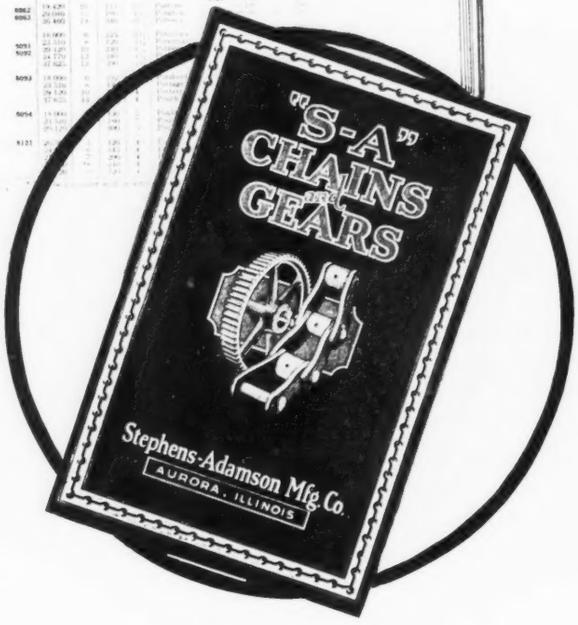

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1924 REVIEW NUMBER AND YEAR BOOK

ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

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The World's Mining Industries

By J. E. Spurr

THE LAST YEAR was one of gradual strengthening and improvement in the various mining industries, taken as a whole: all signs point to 1925 as promising to be the best year for mining since the inflated years during the war. The last year was one of prosperity for the lead industry, of gradual strengthening and improvement for zinc, copper, and silver mining: of a continuation of nip and tuck for gold: and a poor year for the iron industry, especially that of Lake Superior.

Demand for Raw Materials Is Heavy

During the latter part of 1924 favorable indications began unmistakably piling up. Most important was the acceptance of the Dawes plan as a settlement of the greatest European problem. Next was the result of a Presidential contest which to most Americans meant stability, wise government, and progress. The overthrow of the MacDonald government in England was also an event which was encouraging to industry in that country. All these were major symptoms of a general tendency of the world to settle down, work, pay debts, and permit those who labor and make good to enjoy the fruits of their labor. As a result, industrial plans were everywhere pushed forward toward realization, so that the demand for all raw materials has become very heavy. This has accentuated the already stiff demand for lead and zinc: and, in the case of copper, it may be that the near future will see the world's demand catch up with the great capacity for production set up by the successive equipment of many large low-grade "porphyry" copper mines in North and South America. In this increasing demand for the metals which serve as raw material for industrial installations both Europe and America are participating. The iron industry also promises to feel an active demand in 1925.

Mining Industries Prosperous

From the group of great industrial metals, gold and silver are largely excluded. For 1925 there are no indications that the gold industry of the United States will improve over 1924. The prosperity of the gold industry is essentially controlled by the commodity index, which has indeed been rising of late, with small indications of falling much during 1925. In spite of these adverse conditions, the 1924 gold outputs of Canada and South Africa were the largest on record. Silver has a better chance, with its larger industrial use and the increasing sales for coinage to those European countries which are poor in gold and are seeking to get a little real metal money into circulation. Those non-metallic mining industries, such as gypsum, which are largely used in building operations in the United States, prospered during 1924, and will prosper in 1925.

American Capital in South America

The tendencies in the United States during 1924 have been toward consolidation of already great mining companies, a continuation of the movement which was witnessed in 1923. Chino Copper was absorbed by the Ray Consolidated Copper Co. The Anaconda company absorbed the Davis-Daly mines and the Utah Consolidated. Attendant upon this tendency toward greater centralization was a quiet growth in the "trade association" movement. The American Silver Producers' Association was formed.

The increasing relative importance of South American mines and the looming up of African metal mines on the horizon were significant. American capital was invested more heavily in South America, especially the rich mining countries of the South American Cordillera —Peru, Bolivia, and Chile. Guggenheim Brothers' investment in the Chile nitrate fields made the third American interest to enter this field, the first two being the Du Ponts and W. R. Grace & Co. The National Lead Co. became an important factor in Bolivian tin mining, as Guggenheim Brothers had previously done.

World Influences on Mining

Of course, all is never completely roseate. There is always danger that confidence changes to enthusiasm and this to a creation of inflation, followed by the inevitable reaction. In considering the world at large it must be recognized that great upheavals and world-stirring events are still brewing in Asia and Africa, where the ferment will work for a long time yet, and produce results we do not now dream of. Russia, Siberia, China, the Philippines, India, all North Africa, send out unmistakable warnings that the millennium is not visibly nearer than it ever was; and that Asia has yet to rise into power. No one can therefore look far into the future: and all these factors only show that the changes in the mining industries will surely be constant and far-reaching. Mining must be looked on now in an international light, not as an "American" or a "British" or a "Japanese" industry; for it is dependent upon world conditions. The great international mining companies are and will be among the real avatars of world co-operation.

MINING IN 1924

Copper Mining

Substantial Improvement Shown in 1924 Over Previous Year

By Pope Yeatman
Mining Engineer, 165 Broadway, New York

Pope Yeatman

UNLIKE 1923, a year marked by great consolidations and by large increases in production, nothing sensational occurred in the copper industry during 1924. The outstanding features are: (1) increased production, bringing the total to above that of the highest war year; (2) lower costs, in spite of many of the properties operating on lower-grade ores; and (3) greatly improved extraction by the concentration plants, and particularly in the flotation departments, due to better flow sheets, to more careful and systematic work, and to the use of special reagents.

All of the porphyries, as also many of the other mines, are obtaining remarkably improved extraction in their ore treatment. This has been accomplished in many instances on ores of lower grade. One of the most notable improvements has been in selective flotation, by means of which a considerable proportion of pyrite has been dropped and a higher-grade concentrate produced without increasing the loss of the copper in the tailings. By still further cleaning the concentrates, a final product has been obtained that shows a smaller percentage of insolubles. Finer grinding, resulting in less attached pyrite and waste with the copper minerals in the final concentrates, and with higher extraction, has been the rule.

While the increase in copper production has been considerable, the proportional increase has not been as great as that of 1923 over 1922. However, it has been large enough to supply the consumer's needs, though these have been greater than ever before. There has not only been a considerable increase in domestic consumption, but also an increase in copper exported, the latter being attributable to natural causes rather than to the acceptance of the Dawes reparation plan, the effect of which will be more greatly felt in the present year.

The electrical industries in the United States have increased their copper requirements about 25 per cent, and the building industries 12 to 15 per cent, the latter increase being not only due to increased building operations, but also to a greater proportional increase in the use of brass piping, bronze fronts, brass and bronze hardware, and sheet copper in general.

Few copper mines, either on this continent or in South America, have greatly increased their production; in fact, many of them have shown a decrease. At the same time, the capacity is in excess of needs and can be drawn upon whenever required. Among the properties which have shown a notable increase in production may be mentioned the Union Minière du Haut Katanga, of Africa, and the Braden Copper Co. of Chile. One notable example of a decrease in production may be referred to, in the instance of the Cerro de Pasco. The partial curtailment at this property has been due to legal difficulties arising from "smoke nuisance," which will be overcome soon.

The intelligent and energetic work of the Copper and Brass Research Association is proving most beneficial to the industry, and has resulted in the more extended use of copper and the further elimination of substitutes which were introduced during the war. The Research Association, by closer co-operation with dealers, architects, and builders, has greatly advanced the uses of copper, brass and bronze.

The low price of copper experienced during 1924 has necessitated striving for economy, which has resulted generally in lower costs. Those in charge of operations have been "kept on their toes," and mine and mill staffs have been continually seeking for improved methods and more efficient operation. Much interest has been taken in ore leaching, and many of the companies have been experimenting in that direction. Installations of considerable magnitude to be added by companies now employing wet concentration and flotation methods alone may be looked for in the future. There have been no notable improvements in smelting. The tendency has been toward the employment of larger reverberatories and the further displacement of blast furnaces by reverberatories. The blowing in of the smelter of the Magma Copper Co. was an important event of 1924. Labor conditions are much improved and there are fewer complaints of being unable to fill the requirements than there were a year or more ago.

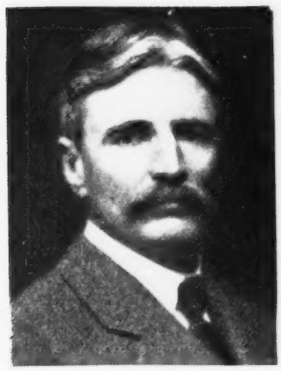
The year 1923 was notable for the consolidation of different properties, but while there have been numerous rumors of consolidations during the last year, no large ones seem to have been consummated, though there has been in some instances a further absorption of one group by another. Stocks of copper have been reduced, but not materially, consumption and production having been pretty nearly equal.

The rehabilitation of Europe, a gradual rather than a sudden growth, will of course help all industries, but copper in particular. The establishment of sane financial adjustments makes the outlook for more extended markets for copper in the comparatively near future most hopeful.

Lead Ore Mining

Industry Prosperous and Another Good Year Indicated

By Clinton H. Crane
President, St. Joseph Lead Co., New York



Clinton H. Crane

IN 1909 it was Mr. Hoover's opinion that "The likelihood of higher prices for lead is more encouraging than for any other metal, as no new deposits of importance have come forward for years, and the old mines are reaching considerable depths."[1] Four years later Mr. Ingalls wrote: "The lead supply is all the time becoming a little shorter with respect to consumptive requirements. This no doubt is the explanation of the increasing strength in the lead market."[2] Whether or not these opinions are now correct, they were frequently expressed in the lead trade during the last year. Be that as it may, the lead production for 1924 was the largest on record, and it is obvious that a continuation of high prices will still further increase the output. The substitution of other materials for some uses has already taken place, and it may well be that the great prosperity of 1924 has done real harm to the lead industry.

The productions of the world and of the United States were both about 12 per cent greater in 1924 than in 1923. In this country practically every producing property was operated at a maximum rate, the high lead prices making profitable the mining of considerable ore which previously had been considered of doubtful commercial value. In all camps the labor situation was eminently satisfactory—there was neither a shortage nor a surplus of men. Cost of living averaged about the same in 1924 as in 1923, but as wages were generally advanced, the miners shared in the industry's boom, and, as reflected by the excellent operating efficiency, were themselves probably more contented and prosperous than ever before. Excluding wages, costs of production varied but little from those of the preceding year.

Freight rates from the Far Western smelters to the East were lowered from 18 to 24 per cent, but a corresponding decrease in the tariffs from Mississippi Valley points has not been announced. For the largest three producing districts, the following table shows the major cost items at the close of each of the last three years, expressed in percentages of the respective figures for December, 1922:

	Southeast Missouri			Idaho			Utah		
	Dec., 1922	Dec., 1923	Dec., 1924	Dec., 1922	Dec., 1923	Dec., 1924	Dec., 1922	Dec., 1923	Dec., 1924
Base wage	100	111	121	100	111	111	100	100	106
Coal	100	101	99	100	92	92	100	71	77
Coke	100	69	67	100	100	100	100	100	100
Powder	100	102	97	100	100	100	100	94	97
Drill Steel	100	104	103	100	102	103	100	109	91

[1] "Principles of Mining" (1909), Herbert C. Hoover.
[2] *Engineering and Mining Journal* editorial; Aug. 16, 1913.

Including the output of the Annapolis Lead Co. in Washington County, Southeast Missouri's mine production set a new record, about 200,000 tons of lead. In St. François County, the operations were confined to three producers, the St. Joseph, National, and Desloge companies. The Ford interests continued their drilling campaign, but if any discoveries have been made, they have not been evidenced by a start on development. The St. Joseph Lead Co. has almost completed a new double-compartment shaft and crushing plant of sufficient capacity to handle the entire tonnage of its Federal mill, at which the shaft is situated. In conjunction with a further extension of primary underground haulage, this shaft will entirely eliminate the surface transportation of this company's ore. Development work was carried on to an unusual extent and the Rivermines mill was enlarged. A further addition to both the turbine and pulverized coal boiler departments of the St. Joseph Lead Co.'s central station has made possible the final shutting down of the old Federal power plant.

The Cœur d'Alenes in 1924 exceeded 1923 in production by a smaller tonnage than would have been the case were it not that the new Hecla plant was not ready to operate until late spring. Furthermore, the famous Hercules met the fate of all good mines—a final shutdown due to exhaustion. Within the last two months the Star crosscut, a joint enterprise of the Bunker Hill and Hecla companies, encountered a downward extension of the old Star vein, thus materially adding to the reserves. A baghouse has been added to the Bunker Hill smelter, which will effect a greater recovery.

In the Salt Lake Valley, all mines were continuously productive, and the Tintic and the Park City districts in particular prospered to an almost unprecedented degree, the high lead price offsetting the lower silver credits resulting from the termination of the Pittman Act in 1923. It is reported that improved metallurgy is about to make available the complex ores of Pioche, Nev. The Shattuck-Arizona Copper Co. has been erecting a hydrometallurgical plant for the treatment of lead ores, which it is expected will much increase Arizona's lead output.

The fourth lead camp—the Tri-state district—exceeded in 1924 its previous record output of 1922, the operations being stimulated not only by the price of lead, but also by the rising zinc market, especially toward the close of the year. The general activity in the Joplin country is almost without parallel.

In 1924 the industry flourished to an extraordinarily unique extent, although general business conditions were only average. But with the financial and political atmosphere of Europe so much clearer, ever since the overwhelming repudiation of vicious radical doctrines in the United States last November, an era of record-breaking prosperity has been forecast for 1925. It is therefore only conservative to predict another prosperous year for lead.

Zinc Ore Mining

The Outlook for 1925 Is Exceedingly Bright

By Arthur Thacher
Consulting Engineer, 900 Security Building, St. Louis, Mo.

Arthur Thacher

THE REVIEW of zinc mining for 1924 is restricted to the mining of ores utilized for the production of metallic zinc, and no reference is made to the mining of ores used in the production of zinc oxide. This will avoid confusion, as most of the ores that are used for making zinc oxide under present conditions could not be used for producing metal. The year 1924 began with a large production. It seemed reasonable to expect a better year than 1923. However, the general business depression of the spring and summer resulted in curtailed production, and the year's results are substantially the same as those of 1923. The year 1923 was a record in the domestic consumption of zinc. The production in three or four of the war years was greater, but the heavy exports of zinc and brass for those years must be deducted, which leaves the domestic consumption of zinc at a lower figure than in the last two years.

Exports for 1924 recorded a material increase, and this is likely to continue, as present conditions point to a growing European demand. As in 1923, the bulk of domestic production came from the Tri-state district, followed by Anaconda, the Franklin mine, Wisconsin, and small amounts from scattering producers. About two-thirds was obtained in the Tri-state district, and, as the United States produced about half of the world's supply, about one-third of the world's supply therefore came from the Tri-state area. An interesting question is the future of this district. Production has steadily increased in the last few years. This has been due to better and cheaper mining, as well as a better ore market. Many estimates have been made showing that there is only a limited ore supply and that at the present rate this will be exhausted within a few years. However, all of these estimates are made upon the basis of present operating cost and the present price of ore. As these two factors change, it becomes possible to mine material that cannot now be regarded as ore, and this will vastly increase the workable area. Operating cost will be constantly lowered, and unless other districts can supply the ore, its price must rise, as the world, with its present standard of civilization, is going to demand an ever increasing amount of zinc yearly.

There are many indications that the Tri-state production will increase. Increasing amounts of capital are being invested and larger consolidations are taking place. With an advancing market, more and more prospecting will be undertaken. The district is extensive, and it is improbable that all the deposits have been discovered. This applies to Miami, Kansas, and Joplin. A striking example is the Joplin district, which a few years ago was supposed to have been worked out, but it is now becoming quite active, both in opening new deposits and in mining older deposits which were supposed to have been exhausted. The richer spots and orebodies similar to those that yielded large profits are probably gone, but it is likely that extensive operations, upon the basis of smaller profits, will prevail in the future and will yield in the aggregate a larger metal production.

In scanning the country for additional sources of supply, the next important producing unit is the Anaconda plant, deriving its ores from the Northwest. This plant employs electrolytic deposition, and, while firmly established with respect to ore supplies, it is doubtful whether it will grow very rapidly. Large capital is required, and the ore supply must be assured to justify the expenditure. The remaining Western area contains many small zinc deposits, but these are scattered and not so favorably situated as to justify the large expense required by an electrolytic plant. Under present conditions the ores are not available for making metal, due to high transportation charges and the cost of smelting the concentrates, which are lower in grade than those obtained from the Tri-state ores. The Mascot mine, in Tennessee, is a good producer, but under present conditions its ore is more valuable for oxide than metal. The only other well-known district is that in Wisconsin. At present this district is contributing only 15,000 tons of zinc per year, but this could be and undoubtedly will be increased in the future. To sum up for the United States, the conclusion is justified that the indications point to increasing domestic and foreign demands and therefore a bright outlook for the industry.

The foreign situation is not so easy to understand. Apparently, the consumption of zinc is materially less than in pre-war days, but this is a condition which cannot continue, as the world will necessarily advance in civilization and will call for an increasing quantity of metals. In pre-war days additional demand was met by Australian production, but the accumulation of zinc concentrates is depleted and the large amount of zinc tailings which formerly furnished the source of a good part of the supply of concentrates has been exhausted. In the future Australia must depend upon ore as mined. It does not appear likely that its production can ever equal former figures. New sources of supply will develop through the world, but some of the older mines are becoming depleted, and it is not likely that the new sources can keep pace with the increasing demands.

It is interesting to note that in the last year small lots of Joplin concentrates have been shipped abroad. Though about two tons of ore are required to make one ton of metal, the sulphur is an important source of supply for acid making in Europe. Moreover, the high-grade Joplin ores are desirable for use in bettering smelting conditions with the low-grade European ores. In any case, this would simply mean that the smelting would be done in Europe and not in this country and would not affect the metal supply of the world. There is no doubt that Europe must draw on this country for an increasing supply of zinc.

Gold and Silver Mining

South Africa and Canada Increase Their Gold Production

By Sidney J. Jennings
Vice-President, U. S. Smelting, Refining & Mining Co., New York

Sidney J. Jennings

THE gold-mining industry proceeded on a fairly even keel during 1924. No discovery of new fields of importance has been reported; nor have any new metallurgical processes been perfected which would bring into economical exploitation mineral previously considered of too low a grade to be commercially important.

On the other hand, in the principal gold fields of the world a consistent policy of increased efficiency of labor and economy in the use of supplies has resulted in an increased profit which has encouraged the leaders of the industry to initiate further expenditure on prospecting.

The gold mines of South Africa, including under that head the production of Rhodesia as well as of the Transvaal, were comparatively free from both governmental interference and labor troubles in 1924. Toward the end of the year unrest began to manifest itself among the native population, which if not wisely and firmly handled may spread so as to be an important economic factor. During 1923 the Transvaal and Rhodesia produced $202,548,840 worth of gold, or in round figures 55 per cent of the production of the world, which is given by the Director of the Mint as $366,940,884 for that year. The figures available for the first ten months of 1924 indicate that the production from the Transvaal and Rhodesia will be increased by about $8,000,000.

The mining of gold in the United States continued to be handicapped in 1924, owing to the fact that the price of gold is fixed and that wages of labor remained high and the price of supplies has increased slightly. The continued wastage of gold by its use on a large scale in the arts has occupied the attention of economists and legislators. During 1923 the amount of gold used in the arts is given by the Director of the Mint as equivalent in value to $69,272,245, of which $40,013,175 was virgin metal. The production of gold of the United States for 1923 was $50,160,103, which continued the decline in production shown by former years.

The development of gold mining in Canada has been distinctly encouraging. The difficulties in the Porcupine district arising from a power shortage are in a fair way to be overcome, and increased crushing capacity is being installed. More prospecting has taken place, and some new finds have been reported. The production of Canada for 1924 will show a material increase over the $25,294,078 reported for 1923, and the outlook for 1925 is encouraging.

The government of Russia and Siberia has not given the encouragement to the gold miner necessary to induce foreign capital to help in the development of its resources on a scale commensurate with their possibilities. Australasia and India will probably continue to show a declining gold production as the old mines become exhausted, and no important new ones have been reported.

The rebellion which took place in Mexico in the latter part of 1923, and which continued during the first part of 1924, had small effect upon the output of silver. During the first eleven months of 1924 the output of silver from Mexico is estimated at 81,500,000 oz., compared with an output of 90,859,083 oz. for the entire year of 1923. This shows practically the same output for the two years. The output of Canada for 1924 is estimated at a slight increase above the 17,754,706 oz. produced in 1923.

In spite of the encouragement given to the mining of silver-lead ore by the high price of lead, the output of silver in the United States is estimated to be about 2,500,000 oz. less in 1924 than the output for 1923. Although the Senate unanimously passed the new Pittman Act directing the Treasury to purchase 14,589,730 oz. of silver at $1 per ounce in completion of the intention of the original Pittman Act, this proposed act was delayed in the House, but will come up at the present session.

The world shows its continued need of silver for coinage purposes. During 1923, 192,237,682 oz. was reported to the Director of the Mint as having been used for this purpose. No difference is made between new and old metal in the report, and so it is not possible to say what proportion of the world's silver output is coined. During the last nine years the amount of silver reported to the Director of the Mint as having been coined has averaged 229,837,888 oz. per year. This use is the main factor in the maintenance of the price of silver, which fluctuated in 1924 between a monthly average of 63.447 and 70.827c. and averaged about 66.66c. per fine ounce in New York.

Iron Ore Mining

Industry Has Higher Hopes for 1925

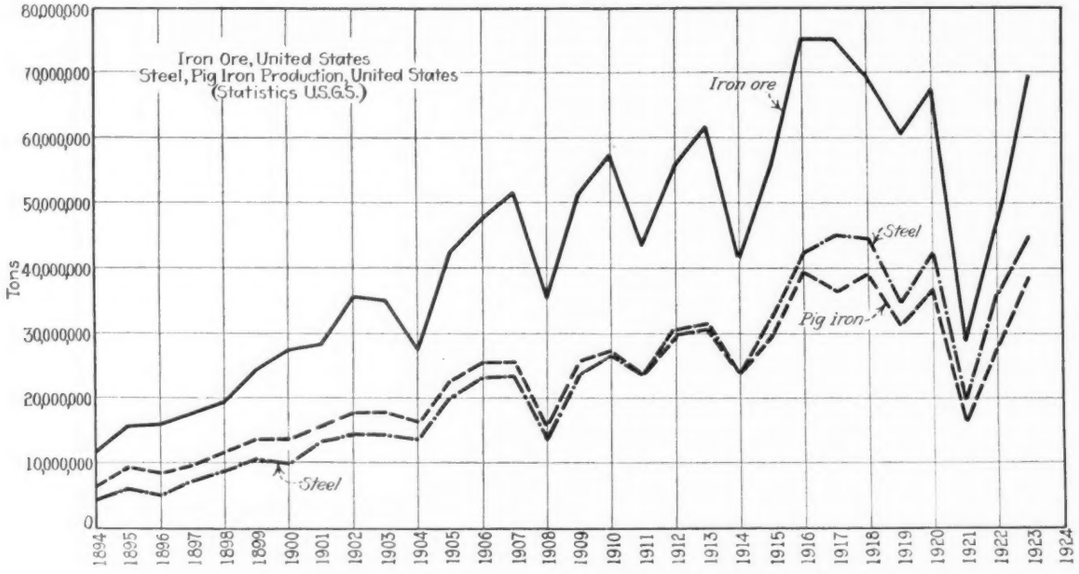
By Dwight E. Woodbridge
Consulting Engineer, Sellwood Building, Duluth, Minn.

LEANER YEARS than 1924 in the Lake Superior iron ore trade may have been experienced, but memory does not recall them. This was not due especially to a small shipment, which amounted to about 43,500,000 tons, Lake and rail, of which 42,630,000 tons was by water, a decrease from 1923 of about 29 per cent. It was the direct result of a general demoralization of the trade brought about by a price cut made a year ago, which cut, drastic as it was, did not measure the full recession from the preceding season, and by a continuance of high costs all along the line—wages, taxes, supplies, overhead, everything. Taxes and overhead were affected by the reduction of output, but not the other items.

Mining companies have been unable to make both ends meet. Small independents were forced out of business for the time being, and those who did operate made nothing. One of the largest concerns, managing many mines for itself and various steel makers, made a profit, but a trifling one, at only three mines on its entire group. Another shows a loss of about $1,000,000 for the year. Taxes had a good deal to do with this. Minnesota produced approximately 31,000,000 tons of ore during 1924, and the mines paid taxes to the amount of almost $27,000,000. As all the ore mined in the state for the year would have realized, if sold, on the market, about $3 per ton at the mine, the tax alone was 29 per cent of its value.

Political uncertainty had also something to do with the situation. Now that this has been removed there is a general revival of activity. In December last a score of idle mines resumed, and half as many more have advanced from a three- or four-day week to full time. Costs will not vary much in 1925, unless it be due to increased taxes in Minnesota, where there is fear that the occupational rate of 6 per cent on assumed profits may be raised by the incoming Legislature to 10 per cent.

One cannot see any new and pronounced trend of technic. The tendency toward larger mechanical units is spreading among operators who have not yet reached the limit established in some mines; electricity for all mine and haulage purposes has been installed at one large open pit, with satisfactory results; economy in methods is necessarily a constant study. The scraper hoist is widely employed. The rivalry among mining-machinery manufacturers brought out in 1924 more efficient machines for underground service. The two new features of ore treatment are the crushing and jigging for hematite separation, as in the plant built by Emmett Butler at Biwabik, and a Dwight-Lloyd sintering installation and screening plant for treating Cuyuna manganiferous ore and hematite. Both are promising. The Duluth, Missabe & Northern Ry. has been experimenting with ore cars of seventy-five gross tons' capacity, and has ordered fifty for spring delivery. These are the largest ever built, and exceed the actual carrying capacity of the large cars of the Great Northern, which are classed as seventy-five net tons, by about twelve gross tons.



Production of iron ore, pig iron and steel—1894-1923

One serious accident, the worst in the history of the Lake iron region, occurred on Feb. 5, 1924, when forty-one men were killed at Milford, on the Cuyuna range, by a rush of mud and water that completely filled the mine in a few moments. Governor Preus immediately appointed an investigating commission. Its report exonerates the mining company, but will form the basis for modernization of the state's official mine

safety standards. Although most operators in Minnesota go to great lengths in safety work, and in that respect are models for the country, the state laws relative to mine safety and inspection have not been changed since they were first passed, many years ago. The care exercised by companies is exemplified by the Spruce mine, on the Mesabi range. Employing 450 men, this mine was operated for fourteen months without a single lost-time accident. The mine has a good deal of bad and swelling ground. The Milford mine, in which the accident noted before took place, was operated during the entire year before the accident, and only two days' lost time resulted from accidents due to underground falls of rock and other causes.

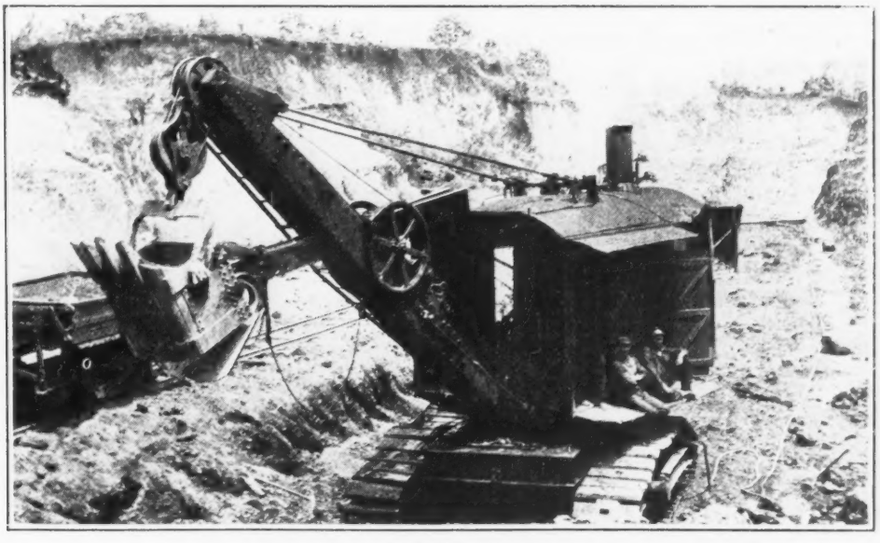
Increase of Silica Percentages in Wash Concentrates Disturbs Leasing Conditions

An especially disturbing situation is the increase of silica percentages in wash concentrates. This may result in a reduction of merchantable ore reserves on the western Mesabi, although it is too early to make definite predictions. Shippers of washed ore from the sandy deposits of western St. Louis and of Itasca county have been unable for some time to correct a continually increasing proportion of silica in their cargo lots. This has been so marked of late that cargoes from mines that used to run from 6 to 7 per cent silica have been around 18 per cent. The Oliver Iron Mining Co., partly to meet this general situation, has canceled leases on three mines near Coleraine from which it has shipped about thirty million tons of concentrates. Fee owners are an element in the situation, as some of them, whose leases permit, are demanding that the term "merchantable ore" shall be construed to mean an assay of 52 per cent iron, instead of the higher percentage which the operator might make and be able to dispose of the ore at a reasonable price. It is needless to say that a 52 per cent wash concentrate, high in silica, is not profitable, under existing conditions. If the land owner can compel the operator to pay for a few units of worthless minerals and thereby add to the tonnage of his land, it is, no doubt, to his temporary advantage to do so. Determined efforts have been initiated by operators and certain land owners to solve the excess silica problem.

It is generally believed that negotiations for the sale of, or at least a portion of, the holdings of the Cleveland-Cliffs Iron Co. to the Ford Motor Co. are again under way. These are not supposed to cover any leases, but many of the fees, including timber lands and transportation facilities. Affiliation of the mining company with certain customers is supposed to be one of the knotty points in this rumored deal. In the meantime the Ford company continues its exploration campaign in northern Michigan, but apparently with as little success as in 1923. Little other exploration is being done, practically none in Minnesota, where all the economic arguments are against discovery in advance of demand. The announcement that the Ontario government is prepared to pay a bounty upon all iron ore produced in the province, to the amount of 1c. a unit of iron in the ore or in concentrates, has aroused interest but as yet no response. Continual rumors of the discovery of ore in Ontario that is merchantable before concentration seem to be unfounded. The proportion of the total iron-ore production of the Lakes region obtained from the different districts is given in the accompanying table:

Proportion of Total Iron-ore Production in Lake Region

Range	1924, Per Cent	1923, Per Cent
Mesabi	67.60	69.87
Gogebic	11.28	10.56
Menominee	9.94	9.50
Marquette	5.91	4.72
Cuyuna	3.04	3.55
Vermilion	2.23	1.80



A Brown Iron Ore Mine at Taits Gap, Alabama

Petroleum

Present Market Stronger

By John D. Northrop
Senior Geologist, U. S. Geological Survey, Washington, D. C.*

John D. Northrop

THE COURSE OF the petroleum industry in 1924 was similar to that followed in 1923. It was determined by the persistence with which the current supply of crude oil, consisting of domestic production and imports, exceeded the current demand as indicated by domestic consumption and exports. Although the net surplus represented only about 4 per cent of the gross consumption, its potency was less a function of its actual magnitude than of its ability to convert the vast stocks of crude oil and principal refinery products accumulated in the periods of excess production in 1922 and 1923 from reasonable safeguards into excessive burdens.

Actual domestic production of petroleum, aggregating about 718,000,000 bbl. in 1924, was about 2 per cent below the output in 1923 and was substantially under aggregate current requirements for consumption and export. Consumption, including exports, increased about 4 per cent compared with 1923, and approximated 761,000,000 bbl., in 1924. Imports, mostly from Mexico, totaling about 78,000,000 bbl., made up the statistical deficiency in domestic production and ostensibly provided approximately 35,000,000 bbl. additional for storage. Almost none of the imported oil was stored, however, as that served for the most part a specialized trade which readily absorbed the available supply. In reality the oil stored during 1924 was wholly of domestic origin and constituted an actual excess of current supply over current demand for strictly domestic crudes.

The sources of excess production in 1924 were California, where the aggregate produced was slightly less than in 1923, though still considerably above local requirements, and the Mid-Continent field, embracing Kansas, Oklahoma, Arkansas, northern Louisiana, and northern and central Texas. The excess in California was less obvious than that in the Mid-Continent because of the facility with which the high-grade California product was transferred via the Panama Canal to the Atlantic seaboard in successful competition with oils transported there by pipe from inland sources. Of California's excess about 10,000,000 bbl. was stored locally and 39,000,000 bbl., more or less, was shipped to Atlantic ports. This influx materially reduced the normal seaboard demand for inland oils and contrived to shift the greater part of the task of caring for the 1924 excess to the Mid-Continent region.

Depressing influences became apparent in the domestic industry early in April, following a period of market advance and general optimism, predicated on the steady decline of the flush fields in California, Oklahoma, Texas, and Arkansas, which were jointly responsible for the excess production in 1923 and 1922. From the trough of the 1923 depression prices per barrel of representative grades of domestic petroleum had advanced prior to April 15, 1924, as follows: Pennsylvania from $2.35@$2.60 to $4.00@$4.50; Lima from $1.43 to $2.28; Mid-Continent (35 deg. Bé.) from $1.00 to $1.75; Gulf Coast from $1.00 to $1.70@$2.00; Salt Creek, Wyoming, from $0.60 to $1.60, and California (25 deg. Bé.) from $0.66 to $1.10.

By the middle of June the results of increased field work began to make themselves felt so emphatically as to dispel a lingering hope that material reduction of existing stocks might be effected before another winter. Burbank, in Oklahoma, had increased its production from 70,000 to 100,000 bbl. per day, and near-by Tonkawa was rejuvenating itself from deeper sands. Elsewhere in Oklahoma, Hewitt was following the example of Tonkawa, and Cromwell and Stroud, late 1923 discoveries, were demonstrating capacities for production far in excess of their earlier promise. In Texas, Powell was holding its own with the aid of compressed air and a small increment of new territory, and Luling was producing 50,000 bbl. per day, compared with only 10,000 at the beginning of the year. In Arkansas, Smackover and its satellites were stubbornly upholding a high rate of production, and in Louisiana, Cotton Valley was claiming a place in the sun. In California, Compton and Dominguez were ascendant and were unmistakably retarding the expected decline of the Los Angeles Basin fields as a whole.

The inevitable readjustment of market quotations began on May 10, 1924, with Appalachian grades, the first to feel the back pressure from the Atlantic seaboard, and progressed generally westward and southwestward, with anticipatory exceptions, reaching the fields of the northern Mississippi Valley July 7, the Gulf Coast July 8, the Rocky Mountain region July 17, and becoming unanimous in the Mid-Continent region July 28. California grades were unaffected, for, although stocks were increasing moderately, production was well in hand and the end of local overproduction appeared to be in sight.

The period of market reaction terminated for Appalachian grades Aug. 21; for Gulf Coast grades Sept. 17; for northern Mississippi Valley grades Sept. 18; for Rocky Mountain grades Sept. 19, and for the principal Mid-Continent grades Sept. 27. The price levels reached before stabilization was effected were slightly above those reached in the depression of 1923, and are indicated by the following quotations per barrel, involving a typical grade from each major field: Pennsylvania, $2.75@$2.85; Lima, $1.58; Mid-Continent (35 deg. Bé.),

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$1.10; Gulf Coast, $1.05@$1.25 and Salt Creek, Wyoming, $0.85. Except for Gulf Coast crudes, which advanced 20 to 25c. per barrel on Nov. 6, in recognition of their lubricating properties, subsequent price movements in 1924 consisted of sporadic minor adjustments, some downward and some upward, which reflected local conditions of supply and demand for certain types of crude, but afforded no conclusive evidence that a general market advance was imminent.

The retrenchment in field operations occasioned by the falling market began to bear fruit in September, but failed to necessitate any net reduction in producers' and transporters' stocks until October, when a little more than a million barrels of storage oil was required to meet current demands. This circumstance, duplicated in November, gave rise to a perceptible undertone of strength in the petroleum market during the remainder of 1924, but induced no tangible revision of price schedules until Dec. 27, when Appalachian grades advanced moderately, "Pennsylvania" closing at $3.00@$3.10 a barrel. Caution begotten of recent experience will doubtless forestall any concerted upward revision until existing stocks, approximating 360,000,000 bbl., are materially reduced. Meanwhile the luckless producer of petroleum is waiting for the full measure of the irrespressible Tonkawa and Cromwell-Papoose districts, in Oklahoma, to be taken and is viewing with undisguised alarm a threat of flush production in large amount from a pool discovered in November at Wortham, Tex.—and gasoline remains at popular prices.

The Lesser Metals

Manganese

By Charles Hardy

Charles Hardy, Inc., 100 East 42d St., New York

During the early part of 1924, the manganese business was exceedingly good, and manganese ore was readily sold for any delivery. As a matter of fact, the demand was so large that the fear existed in Europe that manganese ore could not be obtained in sufficient quantity for the requirements of 1924 and 1925, and contracts were closed to cover requirements for 1924 and some as far ahead as the first half of 1925.

The total importations into the United States during the first ten months of 1924 amounted to 206,147 tons, according to the government statistics, of which 79,665 tons were Caucasian, 40,768 tons Indian, and 45,642 tons Brazilian manganese ore. The remainder came from other countries.

Prices of manganese fluctuated very little in 1924. The year started with quotations ranging from 40 to 43c. per long ton unit, and at the moment of writing, these figures have again prevailed. When, toward the end of April, the industry slumped considerably, manganese ore contracts were in part suspended for later shipments, but as no business to speak of was contracted for at that time, the lower prices then reported were only nominal. No mining of importance was carried on in manganese ore in the United States in 1924.

Ferromanganese fluctuated considerably in price during the year, which started with a price of $109 per long ton. Subsequently one of the English houses, breaking away from the general understanding, caused a price fight which at one time brought prices down to $90. The differences between the dealers seem to have been adjusted, and the price has risen to $105, only $4 below the figure at which 1924 started. A number of contracts were closed during the period of the price fight at from $90 to $95, and the trade seems to be fairly well supplied for its immediate needs.

Imports of ferromanganese into the United States for the first ten months of the year totaled 36,077 long tons. With the business activity continuing as at present, the prospects are that manganese ore and ferromanganese will continue firm, with a tendency to rise during the first half of 1925.

Chromite

By Edward Sampson

U. S. Geological Survey, Washington, D. C.*

During 1924 an unusually large amount of chromite was mined, probably about 240,000 long tons, which is equal to the production of the record year, 1920, and about 30 per cent more than that of 1923. The increase came largely from Rhodesia, where the record production of 1923 was greatly increased. Rhodesia probably furnished about 65 per cent of the world's total in 1924. The imports from India into the United States decreased greatly, owing to a diversion of Baluchistan ore from this market to Europe, where it is largely used in the chemical industry. In Mysore chromite mining continued, and moderate shipments were made to the United States.

The Grecian deposits are being more actively exploited, two mines yielding each about 7,000 tons annually. Most of this ore was exported to the United States for the manufacture of refractories. In New Caledonia, the Tiebaghi mine is being converted from an open-cut to an underground mine. Nearly all of the ore marketed was obtained in development. It is reported that this mine, which has supplied most of the output of New Caledonia, has still a bright future.

The Bethlehem Steel Co. continued to operate its mine in Cuba as a source of refractory ore. In the Quebec field there was little or no activity and in the United States there were no important developments. Domestic production will not exceed a few hundred tons.

The use of chrome brick in the steel industry to replace magnesite brick is increasing. The tariff on magnesite is responsible for the change, but the chrome brick has proved so successful that it will probably be used in place of duty-free magnesite. Much experimental work has been done on a high-chromium iron, which has many of the desirable qualities of high-chromium steel. This material will probably be so largely used in the near future as to affect the chromite market.

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Nickel

By Thomas W. Gibson

Deputy Minister of Mines, Toronto, Ont., Canada

Nickel mining continued to make progress throughout 1924, and production is now much above the pre-war scale. The record of the Sudbury mines for 1913 compared to the first nine months of 1924, is as follows:

	In 1913 —Tons	First Nine Months, 1924— Tons
Ore smelted	823,403	1,012,307
Bessemer matte produced	47,150	48,677
Nickel contents	24,838	25,567
Copper contents	12,938	13,600

The British America Nickel Corporation ceased operations July 21, 1924. The company's mine, the Murray, contains a large orebody. As opened it has produced a low-grade ore, and the company has been handicapped by the fact that it took a great many more tons of ore to make a ton of bessemer matte than in the case of the mines of other nickel companies, notably the Creighton, owned by the International Nickel Co. It is believed, however, that other parts of the Murray mine are richer and contain as much as 4 per cent of nickel and copper combined.

The other operating companies are the International Nickel Co. of Canada Ltd., and the Mond Nickel Co., Ltd., the former an American and the latter an English concern. The International now draws its supply of ore from the Creighton mine, one of the largest and richest of the immense lenses of mixed pyrrhotite and chalcopyrite which characterize the Sudbury nickel field. Creighton ore runs up to 4 per cent and over in nickel, and about 1.5 per cent in copper.

The smelters at Copper Cliff, Coniston, and Nickelton, during the nine months ended with September, 1924, treated 1,012,307 tons of ore, the product of which was 48,677 tons of matte, containing 25,567 tons of nickel and 13,600 tons of copper. This represents an increase of 16 per cent over the figures for 1923. Of the matte, 5,600 tons was exported to the United States and 12,885 tons to Wales. In Canadian refineries, 27,709 tons of matte was treated for a recovery of 19,389,033 lb. of nickel and 12,241,027 lb. of copper, 673 oz. of gold, and 42,869 oz. of silver, as well as 1,255 oz. of platinum, 1,584 oz. of palladium, 367 oz. of rhodium, 266 oz. of iridium and ruthenium. The combined value of the platinum metals was $286,377.

In New Caledonia nickel mining has been resumed, but under difficulties. One of the chief of these is the scarcity of labor prevalent throughout the whole colony. Japanese laborers proved unsatisfactory, and the Société le Nickel recruited its forces with natives of Annam. Exports of matte from New Caledonia during the month of September were as follows:

	Kilos
Société des Hauts Fourneaux:	
From Noumea to Dunkirk.....	200,320
From Noumea to Antwerp.....	235,231
Société Le Nickel:	
From Noumea to Havre.....	475,000

For the previous eight months 3,158,866 kilos was exported, making a total for the first nine months of 1924 of 4,069,417 kilos. The ore exports for the corresponding period from the Société des Hauts Fourneaux were 123,946 kilos.

Tungsten

By Frank L. Hess

Geologist, U. S. Geological Survey, Washington, D. C.*

Tungsten mining during 1924 did little more than mark time while industry caught up with stocks on hand. Economies made necessary by the war greatly delayed the return to normal conditions. Thus, tools ¾ in. or 1 in. thick, 2 in. broad, and 8 to 12 in. long were formerly used for heavy work. With forced economy it was found that, if a tool ¼ in. square, mounted in a tool holder, were kept cool by constantly spraying with a mixture of air and water, a little oil and soda ash, the smaller would do about as much work as the larger tool, and it is believed that this has greatly cut down the consumption of tool steel. On the other hand, high-speed tool steels now seem to be carried in much large stocks than formerly, so as to allow immediate delivery, and these stocks seem to have absorbed considerable tungsten. Other than in these respects little change in the use of tungsten has taken place.

Four companies in the United States made a small production of tungsten ore in 1924, totaling probably not more than 150 tons of concentrates carrying 60 per cent tungstic acid. In Boulder County, Colo., the Wolf Tongue Mining Co. shipped about 100 short tons of ore carrying 55 per cent tungstic acid, part of which was produced by others and by lessees working over the dumps of the company's mines. It paid $10 per unit for ore bought, because the Firth Sterling Steel Co., of McKees Rocks, Pa., in control of the company, prefers to use this particular ore.

Leasers in Nevada produced scheelite from the Pacific Tungsten Co.'s mine near Mill City; the Pacific Smelter & Metals Corporation, with a mine in the Nightingale Mountains, east of Lake Winnemucca, had a mill ready for operation in November; the Lezeart Coal Mining Syndicate erected a dry-concentrating plant on the Summerville deposit in the Pilot Range, 23 miles east of Mina, Nev., and made a little concentrate. All three are contact metamorphic scheelite deposits. The Tungsten Products Co. in California did work on its Pine Creek deposit, but made no production.

China still is the important factor in tungsten production, and except when the tungsten is produced as a by-product, no other country can compete in the open market with its easily mined ore. Although civil war prevented work on the deposits in north and northwest Kwangtung, the deposits in Kiang-si furnished possibly 3,000 long tons, carrying 67.5 per cent tungstic acid (3,800 short tons of 60 per cent WO_3). The alluvial deposits on Shai Wai Shan, near Nananfu, Kiang-si, are practically exhausted and the production is derived now from quartz veins. Burma seems to have produced wolframite only as a byproduct of tin mining. In 1923 the output was 872 long tons, presumably of about 67.5 per cent tungstic acid contents, equivalent to 1,099 short tons of 60 per cent tungstic acid. The production during 1924 was presumably about the same, and, according to the production of the first part of 1924, the Federated Malay States should have produced an equivalent of about 300 short tons of concentrates, nine-tenths scheelite, carrying 60 per cent tungstic acid.

The world's production was probably less than 6,000 short tons of 60 per cent tungstic acid. Prices for Chinese wolframite in the United States ranged around $8 to $8.50 and for good scheelite from $8.50 to $9 per short-ton unit (20 lb. of tungstic acid) during 1924, but some off-color concentrates sold as low as $6.50 per unit. In London published prices for wolframite concentrates carrying 65 per cent or more tungstic acid ranged from 12s. per long-ton unit in January to 9s. 6d. at the end of 1924. With the shilling at 23c. these prices were equivalent to $2.46 to $1.95 per short-ton unit.

Ferrotungsten was quoted through the year at from 87c. in January to 90c. in December for the contained tungsten, and tungsten powder ranged from 95c. to $1. In London prices were nominally quoted through the year at 1s. 4d. to 1s. 5d. (30⅞c. to 32.5c.) for tungsten contained in ferrotungsten carrying 80 to 85 per cent tungsten and 1s. 9d., or 23¼c., for the tungsten powder. Germany under the stress of the Ruhr occupation offered excellent tungsten powder delivered in the United States at 15c. per pound plus duty. On a lot of fifteen tons the cost of the powder was $4,500. The duty at 60c. per lb. specific and 25c. *ad valorem* amounted to $19,125.

Stocks in this country are unknown as to amount, but are probably equivalent to a year's supply, considering scrap steel, ferrotungsten, powder, and ore. Some tungsten came into the country during 1924 as new high-speed steel broken to scrap size. This was apparently not distinctly provided for in the tariff bill of 1922, but the quantity that has been imported has seemingly not been large.

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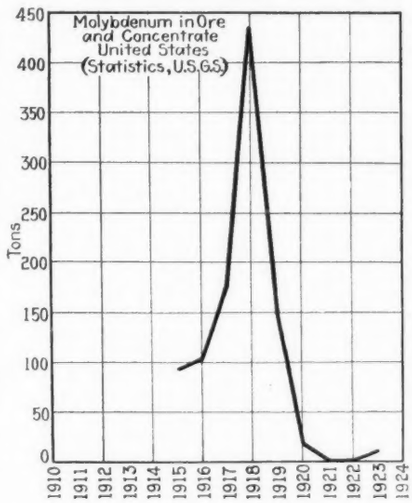
Molybdenum

By John D. Cutter

Vice-President and Metallurgist, Climax Molybdenum Co., New York

The year 1924 was notable in the history of molybdenum because it witnessed in the United States the resumption of mining, which had been dormant since the war period. War stocks were sufficiently reduced to warrant operating on a minimum scale during the latter part of the year. It is doubtful whether this operation will be continued through 1925. Though technical developments continue to be encouraging and the uses of molybdenum are constantly expanding, the demand has not yet reached a point where continuous operations are assured.



Molybdenum production

The thoroughly commercial advantages of molybdenum as an alloy constituent were responsible again for a growing consumption. During the year some of the largest users of alloy steel in the country adopted molybdenum steels as standard. Production was not confined to bar steel, but the manufacture of mill rolls and miscellaneous castings containing molybdenum showed an increased scope.

The most interesting phase of the application of molybdenum to steel during 1924 was the growth of the practice of making the addition to the steel bath in the form of a molybdate in place of the usual ferromolybdenum. This process, invented by Alan Kissock, has advantages which promise to be of great benefit to the alloy steel industry.

Cobalt

By G. C. Bateman

During 1924 the Deloro Smelting & Refining Co., of Deloro, Ontario, was the only smelter on the continent producing cobalt metals and oxides, although there were sales from accumulated stocks by the Coniagas Reduction Co., of St. Catharines, Ontario, which is no longer operating. Production is difficult to estimate, because the only published figures are derived from the smelters, and as the Deloro company has large supplies of raw materials, its output is not a reliable index to the amount of ore produced. For the first nine months of 1924, a production of metallic cobalt was made valued at $346,177, a decrease of $185,000 compared with the corresponding period of 1923; cobalt oxide valued at $620,587, a decrease of $18,500, and mixed oxides and residues valued at $391,124, an increase of $210,000.

Probably some increase in supplies has resulted on account of the high cobalt ores of South Lorrain, but there has been little change in the price paid. The mines receive approximately 3½c. per unit per pound, and the cobalt metal sells for about $2.50 to $2.75 per pound. The price per pound of cobalt received for the raw ore is the product of the percentage of the cobalt contained and 3.5c.

No particular changes have taken place in the metallurgical treatment of the ores, and no new important sources of supply have been opened, aside from the probable increase from South Lorrain. The demand for the metal has been steady, and it is understood that new uses are being developed, particularly in nickel-cobalt alloys, which show indications of a substantial consumption. Producers of both the ore and the metal are faced with competition by the Tanganyika interests, of Africa. It is expected that within a few months supplies of ferrocobalt from this source will be on the market and that within a year the company will be producing cobalt oxide, which may result in a readjustment of prices.

Platinum

By James M. Hill

Geologist, U. S. Geological Survey, San Francisco*

Stocks of the more important platinum metals in the hands of refiners on Jan. 1, 1924, were: Platinum, 36,554 oz.; iridium, 5,208 oz.; and palladium, 26,266 oz. Thus the year started with a normal stock of platinum and iridium, though there was less of both of these metals than at the beginning of 1923. Palladium stocks were considerably larger than normal. The domestic production of placer platinum was smaller than in 1923 and is estimated at less than 400 oz. Gold and copper refiners recovered about the same quantity of the platinum metals in 1924 as in 1923. The domestic output of refined metals is estimated at 3,000 oz., of which about two-thirds was platinum and one-third palladium, with a minor quantity of the "by-metals." The Wyoming excitement of December, 1923, has not been heard from and is not believed to be of importance.

Imports for the first nine months of 1924 were: Platinum, 67,096 oz.; iridium, 1,207 oz.; and palladium, 7,873 oz. At this rate receipts for the year should be platinum, 94,500 oz.; iridium, 1,600 oz.; and palladium, 10,500 oz. Iridium and palladium will probably come up to the average, but platinum will decline. Reports indicate that shipments from Colombia, which averaged 3,650 oz. a month during the first nine months of 1924, will be curtailed for the remainder of the year. Colombia supplied nearly 50 per cent of the platinum imported during the period for which figures are available. Iridium imports are at about the normal rate, but imports of palladium are almost 25 per cent less than in 1923.

Quotations for platinum at the first of 1924 were $122 an ounce, but advanced to $125 by the middle of February. In the middle of March the price began to decline, and it reached the low point of the year, $115 an ounce, early in April. There was an upward trend beginning in May, but the price did not reach $120 until the last of July, and by mid-September it was down to $118, which quotation has been maintained since. Iridium was quoted at $275 to $300 an ounce during the first five months of 1924, but since June 1 it has been nominal at $260 to $270 an ounce. Palladium started the year at $107 an ounce and until June 1 was quoted at $100 to $110; since then quotations have been $78 to $83, being $80 for a short period early in October, but rising to $83 at the middle of the month. Osmium quotations were $95 to $104 an ounce throughout 1924, and rhodium, which opened at $100 to $105 an ounce, dropped to $85 to $90 in June. On the whole, the market was narrow, with relatively small supplies, and a weak demand, particularly emphasized by smaller buying for jewelry. Jewelers are still working on details of the "Stamping Law" for platinum articles.

The Russian situation is still obscure. Reports indicate that two dredges started on the Kytlyn were forced to suspend operations because of an accident to the electric power plant. It is not believed that the production during 1924 will exceed 40,000 oz.

In Colombia, the South American Gold & Platinum Co. operated three dredges, which recovered during the first eight months of 1924 nearly twice as much platinum as in the corresponding period of 1923. The hydro-electric plant was completed in October, and the two dredges, which will operate with this power, were being reconverted and so made little production during the rest of the year. The British Platinum & Gold Co. operated two boats after April and produced 3,225 oz. of platinum during the first nine months of 1924. The Colombian production is estimated at 45,000 oz.

Development of the Transvaal platinum deposits, which discovery was announced in 1923, was continued, and reports are hopeful that a mine of moderate size will result. Osmiridium is being saved on the Rand and in Rhodesia, but the production from Tasmania is falling off, and it is reported that deposits carrying osmiridium are becoming very difficult to find in the last-named country.

Production of platinum metals in Canada has increased considerably. The output during the first six months of 1924 was 135 oz. of platinum, 1,795 oz. of palladium, 211 oz. of rhodium, and 152 oz. of osmium, practically all of which was recovered by the electrolytic nickel refineries.

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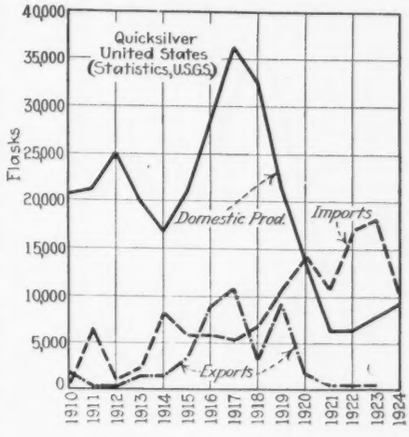
Quicksilver

By H. W. Gould

Mining Engineer, Hobart Building, San Francisco

Quicksilver production in the United States during 1924 will probably show a healthy increase over 1923. The outlook for the industry is much improved. The price of quicksilver was fairly steady during 1924. It increased from $60 per flask a year ago, to more than $70 at the close of the year. The condition of the market is healthy, as the demand is fair, and there are no large stocks of metal on hand in the United States.



Quicksilver production

Heavy importations from Spain and Italy continue, since the United States, as a result of the depression of the industry following the war, produces less than one-third of its requirement. The heavy consumption of quicksilver in this country is a hopeful sign, and a general resumption of business activity in Europe would greatly strengthen the market abroad and consequently in the United States as well.

The bulk of the domestic production still comes from four mines, the New Idria, New Almaden, and Cloverdale, in California, and the Chisos mine, in Texas. Several old mines are being reopened in California and two new reduction plants are under construction. Nevada made a small production early in 1924 from the Gold Banks mine, and considerable activity is reported in the Mina district. No new work of importance is reported from Texas or Oregon.

The situation abroad is much the same as in 1923. Italian production at Monte Amiata and Monte Labro, the last a new producer in northern Italy, shows an increase, but the old Idria mine, in Carniola, seems to be on the decline. Italy will probably produce over 50,000 flasks of quicksilver in 1924. At Almaden, in Spain, the output declined in 1923 to 32,923 flasks. What 1924 will show is problematical, as a complete change of management at the mine was reported early in the year.

No pronounced improvements were made in the metallurgy of quicksilver during 1924, but several new uses were found for the metal. The Emmet boiler, if proved to be a success, will use large quantities of mercury and greatly stabilize the market. The outlook for quicksilver in 1925 is promising.

Antimony

By H. K. Masters

Mining and Metallurgical Engineer, 111 Broadway, New York

No metal has been subject during 1924 to such price fluctuations as antimony. Opening the year at 9¾c. per lb. in carload lots, f.o.b. cars New York, the price rose, on good demand and in sympathy with prices of all metals, to a peak in March of 11¾c. This rise was aided by the fact that stocks were below normal, insufficient time having elapsed to rebuild them from the low point brought about by the disturbances in China during the late summer and early fall of 1923.

From the high price of 11¾c. in March there was a rapid decline due to lessened demand, as business activity fell off, and as arrivals increased, until in May the metal sold at 8¼c., which price may be said fairly to represent the market, well into July. Renewed disturbances then broke out in China, where civil war flourished for several months, almost completely shutting off supplies, so that arrivals in New York, (as reported by the New York Metal Exchange) for the months of June to October inclusive, totaled only 2,137 tons, compared with 4,614 and 4,155 tons for the corresponding months of 1923 and 1922 respectively.

The price rose steadily as stocks diminished and buyers began to have a realization of the situation, until at the close of 1924 spot metal was very scarce and unobtainable at less than 17½c. per lb., with very limited supplies due to arrive during January, February, and March, 1925 priced at 15¾c., 15c., and 14¾c. in bond, the import duty being 2c. per lb. For such positions as December and January shipment from China the price was approximately 14½c. c.i.f., New York. This closing New York spot price of 17½c. is the highest since June, 1917, and compared with the price at the close of 1923 of 9¾c. and an average price of 7.43c. for the five pre-war years 1909-1913, inclusive.

Stocks in Europe are reported to be light, and unless the Chinese production can soon come forward to the world's markets, industry will be obliged to look elsewhere than to China for antimony. Present prices, if continued, will undoubtedly tend to bring such former producers as Bolivia, Australasia, Canada, Argentina, Italy, and Mexico back into production and it is even possible that domestic properties might be profitably worked at these prices.

In technology the only new development of interest concerns the application of the Harris process for refining lead, by means of which antimony (together with other metallic impurities) is removed in a form readily reducible to the metallic state. The process is reported to have made recoveries approaching 99 per cent of the antimony present.

Arsenic

By Hamilton M. Brush

Vice-President American Smelting & Refining Co., New York

Stocks of refined arsenic in the hands of the principal producers of arsenic on Jan. 1, 1924, were approximately 1,100 tons. It is estimated that corresponding stocks on Jan. 1, 1925, were about 5,500 tons; and it is estimated further that the stocks of calcium arsenate amounted on Jan. 1, 1924, to approximately 10,000 tons, compared with less than 2,000 tons a year ago. This would indicate an increase in the stocks of refined white arsenic and arsenical contents of calcium during 1924 of approximately 8,000 tons and a total consumption of about 19,000 tons of arsenic.

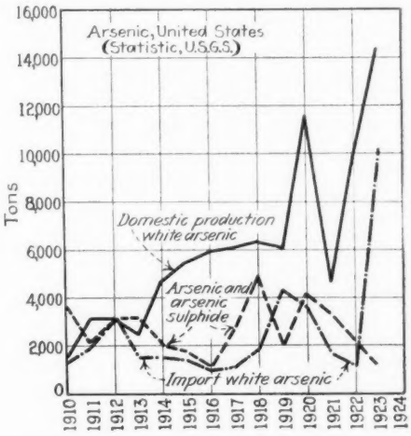
The figures given in the accompanying table, which I believe are fairly accurate, tell the story of arsenic during 1924. The price, starting at 13½c. in January, showed a progressive decline, and at the end of the year was 40 per cent of the quotation at the beginning. The decline was rapid for the first six months and thereafter gradual.

1924	United States Production Refined (*a*) Tons	Imports (*b*) Tons	Total Arsenic Available, Tons	Price per Pound (¢), Cents
January	1,901	962	2,863	13.50
February	1,399	772	2,171	12.56
March	1,791	1,090	2,881	12.25
April	1,656	1,024	2,680	11.12
May	1,487	1,193	2,680	10.12
June	1,486	1,036	2,522	8.52
July	1,622	768	2,390	7.81
August	1,674	285	1,959	7.71
September	1,385	339	1,724	7.42
October	1,224	652	1,876	7.00
November	1,200 (*d*)	500 (*d*)	1,700 (*d*)	6.67
December	1,200 (*d*)	500 (*d*)	1,700 (*d*)	6.62
	18,025	9,121	27,146	

(*a*) American Bureau of Metal Statistics.
(*b*) *Oil, Paint and Drug Reporter.*
(*c*) *Mining Journal-Press.*
(*d*) Estimated.

The total approximate consumption of arsenic in the United States for the years 1914 to 1918 inclusive was at the rate of 7,200 tons per annum; for the years 1919 to 1923 inclusive, at the rate of 13,800 tons per annum; for the year 1924 it was approximately 19,000 tons. From this it appears that the fall in the price was occasioned not by a decreased consumption but by a largely increased production. In spite of the light infestation of boll weevils, domestic consumption of arsenic broke all records except that of 1923.

Comparative stabilization of price during the latter part of 1924, in spite of increasing stocks and the falling off in imports from all countries, except



Arsenic production in United States

Mexico and Japan, where the cost of production is very low, indicates that it had reached a level unattractive to many of the producers and probably, therefore, closely approaching the cost of production. In some cases, without doubt, this has already been passed.

Arsenic appears to have established itself as an important commodity. It is to be expected that, as production and consumption have increased, both will continue to increase in the future with a stable price at a level which will give the lower-cost producers a fair profit margin and will put arsenic into the hands of consumers at a price which they can well afford to pay. This position when it has been reached will encourage further improvements in methods of mining and reduction.

Bismuth

By F. Y. Robertson

Vice-president and Manager Metal Sales, U. S. Smelting, Refining & Mining Co., Inc., 120 Broadway, N. Y.

The production of bismuth in the United States is approximately 300,000 lb. annually, and is obtained mainly as a byproduct from the treatment of lead bullion by the United States Smelting, Refining & Mining Co. and the American Smelting & Refining Co. The foreign production of bismuth is controlled almost entirely by English in-

terests which own or control the principal mining properties in Bolivia and elsewhere throughout the world, the ores of which carry bismuth, usually along with other valuable metals. It is understood that these properties are capable of producing the world's requirements of bismuth, if necessary.

In recent years there has been exported from China a considerable tonnage of high-grade bismuth ores, the bulk of this tonnage running from 45 to 65 per cent in bismuth content. The greater part of these ores have been shipped to England for treatment. Owing to the internal dissension and war in China, and possibly to the exhaustion of some of the properties, these shipments materially decreased during 1924.

Bismuth has a limited market, and there seems to be no way in which the demand can be increased. During the late war the demand for bismuth assumed large proportions owing to its use in antiseptic surgical dressings and medicines, but since the close of the war this demand has greatly decreased. Its use in the manufacture of cosmetics, face powders, and similar products has in part made up for the lessened demand for surgical and medicinal uses, but the consumption of bismuth is not sufficient to keep pace with the world's normal production, and as a result there is an accumulation of large stocks of refined metallic bismuth.

Refined bismuth metal when used for medicinal purposes in the United States must be of a purity to meet the requirements of the United States Pharmacopœia standard, which provides for the Betendorf method to determine whether arsenic, lead, or injurious impurities are present. The bismuth produced by the United States Smelting, Refining & Mining Co. and the American Smelting & Refining Co. conforms to this standard and equals in purity the best foreign brands.

During 1923 and the early part of 1924 the price of bismuth, as fixed by Johnson, Matthey & Co., of London, was 10s. per pound, which on Aug. 18, 1924, was reduced to 7s. 6d., and on Nov. 11, 1924, there was a further reduction to 6s., with a probability that the price will be still further reduced. The outlook for higher prices of refined bismuth is not encouraging unless new uses are discovered or the present large stocks are considerably reduced.

Radium, Uranium, and Vanadium

By Frank L. Hess

Geologist, U. S. Geological Survey, Washington, D. C.*

The 1924 story of radium and uranium in the United States is short and holds little encouragement for the miner. Of the principal companies, only the U. S. Radium Co. separated radium or mined ore. It leased the carnotite property of the Keystone Metals Reduction Co. on Polar Mesa, north of the La Sal Mountains, in Utah, and mined ore, but the deposits are reported to have proved much leaner than the drilling records indicated and operations were stopped early in the fall. Leasers mined ore on the company's property in Long Park, Colo., and a little ore was mined by others in the vicinity. On the south side of the La Sal Mountains work was done and a little ore was shipped to Los Angeles for medicinal use. Work was also done on the claims of the Radium Corporation of Colorado, south of Gateway, Colo. The Kearns-Clark claims of the corporation on Dry Wash, 45 miles southeast of Moab, Utah, were sold during the year, and it was reported that a mill was being built to extract vanadium from the ore.

Belgian radium ruled the market, but in this country the uncertainties caused by the drop in price and, in Europe, the lack of money, have left few buyers, and even the Belgian radium works are reported to have closed down temporarily. British and French plants are also reported closed, and Czechoslovakia has suffered severely from the drop in the price of radium.

At Rifle, Colo., the U. S. Vanadium Co. leased the roscoelite (?) deposits on East Rifle Creek, 11 miles northeast of Rifle, and erected a mill on the railroad at Rifle. The Vanadium Corporation of America has remained the principal factor in the world's vanadium business. During the year it shipped large quantities of oxidized vanadium ores from its mines at Mina Ragra, Peru, and has laid its railroad from Lake Pun-run to Ricran on the Central of Peru railroad. A new export tariff was put into effect by the Peruvian Government that decreases the heavy tax recently imposed. During 1924 the company continued smelting the accumulated slags at its Bridgeville, Pa., plant.

Little is known of the shipments of the lead vanadates from southern Africa, but it is supposed that they have been continued. Mexico is also a prospective producer of lead vanadates. Some European inquiries for lead vanadates have been coming to America. What may possibly be a significant development in the vanadium situation is the production of vanadium as a by-product of fertilizer production from phosphate rock, to which attention has been called before. It has been found feasible to separate the vanadium oxide from the phosphatic solutions, and although the percentages are small, the total quantity produced per year is large, so that producers and users may have to give the subject serious consideration.

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Uncommon Ores and Metals

By H. C. Meyer

Vice-President, Foote Mineral Co., Philadelphia, Pa

THE DEMAND for cadmium in 1924 apparently did not keep pace with its production. This resulted in a demoralized market and drastic price reductions. If new uses are not developed, it is almost certain that the production will be greatly curtailed during 1925.

In the first half of 1924 the price ranged from 70 to 75c. per lb. Toward the end of the first half the price dropped to 60c., and it remained at that figure throughout the rest of the year, although it is almost certain that a lower figure than this could have been secured on quantities of a ton of more. The major demand for cadmium is in the plating industry. Cadmium sulphide is used in the glass and pottery trades. Prices on the sulphide ranged from $1.27 to $1.35 during the first half of 1924, and from $1.18 to $1.20 during the last half, in lots of 1,000 to 2,000 lb.

Owing to the bitter competition existing, it is impossible to get authoritative figures upon the probable 1924 production of cadmium. It seems safe to assume, however, that it was approximately 150,000 to 160,000 lb. The production of the sulphide is generally about the same as that of the metal.

Cerium—No important new uses were developed for cerium or its alloy, ferrocerium, during 1924. If a commercial demand should arise, cerium could be produced at low prices. Under present conditions, however, the imported metal sells at around $5 per pound. The ferro-alloy is quoted in bond at around $3.75 to $4 per pound. Domestic ferrocerium sells at from $10 to $15 per pound. The absence of real competition prevents securing data as to its actual consumption. Cerium, or mixmetal, as it is sometimes called, due to being associated with lanthanum and didymium, has been used on a semi-commercial scale as a deoxidizer. It is very active at fairly low temperatures, and, owing to its inflammable nature, it is more difficult to handle than magnesium. The only real commercial use for ferrocerium is in sparking devices, such as gas lighters and pocket lighting devices used by smokers. The remarkable physical and chemical properties of cerium will undoubtedly result in finding a widespread use.

Selenium—The price of selenium was firm throughout 1924—$2 to $2.10 per pound, depending on quantity. No important new applications were developed. No important progress was made in developing the Siberian supply, but the Mexican production showed a slight increase over that of 1923. As soon as this foreign source of supply is more firmly established, it is reasonable to assume that a reduction in price can be looked for.

Statistics are not available on the actual production during 1924, but it is unlikely that it exceeded fifty to sixty tons. A considerable quantity of the American production is exported.

Tellurium—A real commercial use for tellurium has not yet been developed. Large quantities of it are available, and by suitable methods a great deal that now goes off in fumes from the smelters could be recovered. In its physical and chemical properties it resembles closely sulphur and selenium. There was a slight recession in prices

of tellurium during 1924. In the first half it was quoted at around $1.75 to $2 per pound, but during the last half it was offered for as low as $1.50 per pound.

Thallium—The fact that this element resembles lead so closely in its physical and chemical properties seems to have somewhat retarded its commercial application. Its chief source of supply is the flue dust from sulphuric acid plants where pyrite is used. The content of thallium in such flue dust varies, but in some instances it is present in quantities of one-half of 1 per cent up to as high as 1 per cent. It is readily extracted by a simple chemical process. As statistics show, the United States and Germany are the only producers of thallium. The element appears on the market in the form of sticks and small pigs or ingots. It has the luster of lead on a fresh surface, but rapidly becomes coated, under normal atmospheric conditions, with a protective film of thallous oxide.

Production greatly exceeds the demand. The ruling price during the first half of 1924 was $8 per pound. During the last half the quotations dropped to $5 per pound, in 25- to 50-lb. lots. Only a few minor uses have been developed. It has been used in optical glass to increase the refractive index, in a photo-electric cell, and the salts (principally the acetate) are used for medicinal purposes. The total world production probably does not exceed 500 lb.

Titanium—The two ores of titanium, in the order of their importance, are ilmenite and rutile. The former is used principally for the production of ferrotitanium. This alloy is used in large quantities as a scavenger or deoxidizer in the manufacture of open-hearth steel.

The important use of rutile is in the ceramic industry, where it is used as a coloring agent to produce soft browns and yellows. It is the only pigment which will stand extremely high temperatures without bleaching or fading.

The prices on ilmenite and rutile remained firm throughout 1924. Rutile ranged from 12 to 15c. per pound for the American product and from 10 to 12c. for the Norwegian. Ilmenite concentrates in carload lots ranged from $10 to $20 per ton. No accurate figures are available as to the exact consumption of either mineral.

Thorium—The demand for thorium ore (monazite sand) was slight during 1924. The incandescent mantle industry, the only important consumer of thorium in the form of the nitrate, purchased this chemical from foreign sources, which even under the high duty was cheaper than it could be manufactured in the United States from duty-free monazite sand. Large quantities of Indian monazite running 8 per cent thorium oxide were offered at low figures but with no takers. Brazilian monazite sand, minimum 6 per cent thorium oxide, was quoted at 6c. per pound in carload lots and the Indian sand was approximately 20 per cent higher in price.

A comparatively small quantity of thorium is consumed in the manufacture of tungsten filaments for incandescent lamps. This thorated tungsten wire is also largely used in the filaments of thermionic valves, or radio tubes. The thorium in this case increases the electron emission when the filament is heated. Some interest was shown in the use of thorium oxide as a refractory, and this may serve to stimulate the monazite-sand market. However, the logical use for monazite is as a source of cerium metal.

Zirconium—No important increase in the demand for zirconium ores was noted in 1924. Both the natural oxide (zirkite) and the silicate (zircon) continued in demand for refractory purposes. There was a greater call for calcined zirkite in granulated form, and an electrically sintered grade is now on the market. By mixing a certain percentage of raw zirkite cement with the calcined product, a very excellent refractory body is obtained for the manufacture of standard firebrick shapes and crucibles, as well as special shapes for high-temperature work.

Standard nine-inch zirkite bricks continued to sell at $750 per thousand during 1924; 70 per cent zirkite cement remained firm at $50 per ton in carload lots; 80 per cent zirkite cement, having a higher melting point than the 70 per cent grade, sold at $100 per ton in carload lots during the first half of the year and dropped to $60 per ton during the last half. Zirconium metal powder remained unchanged in price—$30 per pound in 5 to 10-lb. lots. Ferrozirconium, zirconium-ferrosilicon, and silicon-zirconium remained firm, standard ferrozirconium selling at $3.50 per pound of zirconium metal content in 500 to 1,000-lb. lots.

The most important development during 1924 was the appearance on the market of pure zirconium oxide in commercial quantities at commercial prices. This oxide is pure white and carries from 98 to 99 per cent zirconium oxide. It is being offered at competitive prices with tin oxide, and it is hoped that a very large demand will develop in the enameled metal-ware industry. Besides being an excellent opacifier, it imparts properties to the enamel not given by tin oxide. Prices on the pure oxide, sold under the trade name of "Zirkonalba," ranged from 65c. to $1 per pound during the first half of 1924. During the second half a recession in price occurred, and prices ranged from 56 to 75c. per pound.

The Non-Metallics

Asbestos

By Norman R. Fisher
Consulting Engineer, Thetford Mines, Quebec, Canada

Conditions generally were none too satisfactory in the Canadian asbestos industry during 1924. Demand and the output were records, but unfortunately for the industry it is now equipped to produce much more than the world's present maximum requirements. Altogether about 270,000 tons of the raw asbestos was consumed in 1924, about 80 per cent of which was supplied from Canadian mines. The productive capacity of these mines is in excess of 360,000 tons per annum.

Efforts have been made, from time to time, to bring about an equitable agreement among producers in respect to the division of this limited demand, but, instead, intense competition, accompanied by senseless price cutting, has continued to prevail. As a consequence, only those mines blessed with either better than the average grade of rock or more favorable operating conditions continuously worked to capacity throughout the year; a few others, not so favored, worked only intermittently or to part capacity, and a number had to remain idle throughout 1924.

Despite a substantial increase in shipments during the year, the prices of practically all grades of asbestos fell considerably. In 1923, though Canadian shipments were the largest ever recorded—216,804 tons—the average price dropped to $33.97 from $37.75, which prevailed during 1923, when only 160,339 tons was shipped, and compared with $81.99, the record price of recent years established in 1920, when 179,891 tons was shipped. Complete figures are not available for 1924, but those that are indicate that, though there was a still further increase in shipments, establishing a new record, the decrease in price was more than $3 per ton. The persistent drop in prices is due in no small measure to the increasing proportion of lower-grade material being used and the practice of substantially improving the grade within any given class without commensurately increasing its price, but principally to the competition among the producers themselves, both local and foreign.

Foreign competition arises chiefly from the asbestos producers of Rhodesia and the Union of South Africa, who are rapidly becoming important factors. In 1924 they shipped about 40,000 tons, which is only say 20 per cent of Canada's output in quantity, but, being composed principally of the longer, more valuable grades, actually represents more than 60 per cent of it in value.

To combat successfully the ever-increasing loss of its long-fiber business, so long the most profitable of the Canadian asbestos industry, Canada must continue to cut, even more drastically than ever, the price of her longer grades to meet foreign competition in them, but at the same time must increase, as far as practicable, the price of her other grades. Success in this direction can be attained only by united action through a central body controlling production and sales.

Costs are not made public by any of the mines. Information on values and tonnages is, however, published periodically. In 1923, the 3,747,574

tons of rock, yielding 216,804 tons of asbestos, had an average value of only $1.96 per ton. In 1924 the average extraction of asbestos was higher than that obtained in 1923, but the lower price realized will make the average value of the rock from which it was recovered even lower than $1.96 per ton. With such low-valued material extremely low working costs, which happily obtain to a remarkable degree throughout the district, are essential to permit of any profit being made, yet the situation is made more difficult by the constant dwindling in the value of the product without compensating decrease in the cost of labor and supplies.

At present all asbestos is recovered from its matrix by dry methods, but during the last year or so intensive experiments have been conducted by the Selective Treatment Co. with the object of developing a successful wet process. The company now officially claims that it has perfected a wet process which shows, in comparative working tests, both economies in operation and more efficient extraction than is obtainable by any known dry process, a claim which, if demonstrable in practice, should do much to offset the great drop in prices.

Bauxite and Aluminum

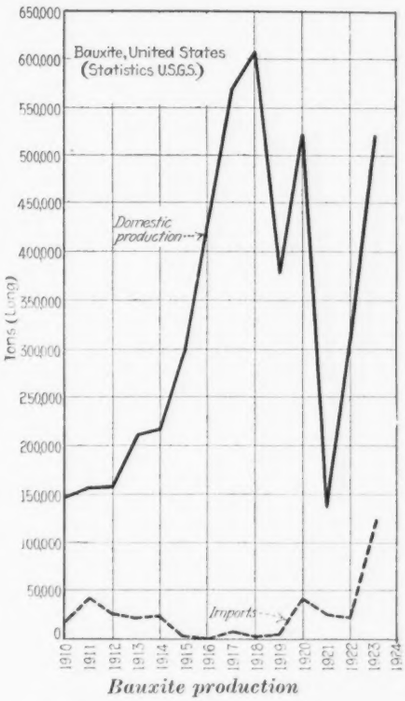
By James M. Hill
Geologist, U. S. Geological Survey, San Francisco*

It is estimated that the domestic production of bauxite in 1924 will be approximately 30 per cent less than that for 1923, when 522,690 long tons was mined, though the production may be as much as 380,000 tons. Arkansas production decreased nearly 30 per cent, notwithstanding the fact that two new companies were operating. Georgia production was also less. Development of the recently discovered deposits in Mississippi and Alabama was continued. Domestic bauxite was quoted throughout 1924 at $5.50 to $8.75 per ton, and foreign at $5 to $7.50 per ton, eastern ports. South American bauxite has been used more extensively by the makers of chemicals.

Imports of bauxite during the first nine months of 1924 totaled 153,709 tons, largely from South America, compared with 84,796 tons in the same period of 1923. Imports were maintained at approximately 18,000 tons a month during the last months of the year, and receipts for the year should be about 210,000 tons. Supplies of bauxite for 1924 were approximately 570,000 tons, or 11 per cent less than in 1923.

Exports of bauxite and bauxite concentrates to Canada and Norway were slightly greater during the first nine months of 1924 than in 1923, the figures being 59,872 tons and 57,327 tons, respectively.

The domestic demand for aluminum decreased in 1924, compared with that for 1923, particularly in the automobile industry. The production of automobiles during the first six months of 1924 declined about 4 per cent, and the rate of production since then has declined. The industry is turning to pressed steel and molded fabric in place of aluminum.



Bauxite production

Imports of crude aluminum during the first nine months of 1924 were 21,615,407 lb., indicating a decrease of 36 per cent compared with those for 1923. Imports of plates, sheets and bars likewise declined approximately 17 per cent compared with those for 1923, the imports for the first nine months of 1924 being 772,766 lb. Exports of crude aluminum during the first nine months of 1924 were 2,910,445 lb., indicating an increased export of over 200 per cent, compared with those of 1923. Semi-manufactured aluminum has likewise been exported in greater quantities, the increase being nearly 25 per cent during the first nine months of 1924, when 4,596,199 lb. was exported.

Open market quotations on 99 per cent aluminum were 28c. per pound, except for the period April to July, when they were 28 and 29c. The 98 per cent grade was about one cent lower than the 99 per cent throughout 1924.

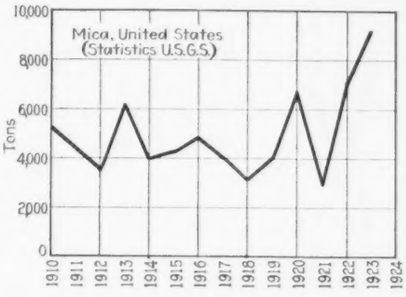
Mica

By J. A. Rogers
Ruggles Mining Co., Rumney Depot, N. H.

Mica production in New England, 90 per cent of which is mined in Grafton County, N. H., has at least kept pace with, if not outstripped, the production of 1923, and though little information can be obtained as to operations in the South, it is expected that New Hampshire will lead the states in production during 1924.

The Alexandria mine of the General Electric Co., situated near Bristol, N. H., was in continuous operation during the year, and has proved to be a consistent producer. In fact, this mine, under the management of George W. McNaughton, mines manager of the General Electric Co., has been practically in constant operation since 1916 and has probably produced more white mica than any other mine in America, during that period. The company, under the direction of McNaughton, has begun the development of another mine in Grafton County, known as the Danbury mine, a few miles from the Alexandria, and this is developing in a satisfactory manner. Two new shafts have been completed at the Alexandria mine.

The Standard Feldspar Co. took over and continued the operation of the properties of the Ruggles Mining Co., the Federal Lumber Co., the J. A. Rogers, and the Commercial Mica Co. on July 1, 1924, later, also, securing the Baldwin and other properties in Groton, N. H. The properties of the Standard are situated in Alexandria, Rumney, Grafton, Croton, Hebron, and Orange, N. H. The company has three mines in operation, the Ruggles, in Grafton, upon which mining was first begun in 1803, and the Plume and the Baldwin, in Groton, all of which are producing both mica and feldspar. These mines have no doubt exceeded previous records in output, and report satisfactory market conditions. The increased production of radio equipment,



Mica production

in which mica enters as an essential material, has been a great help to the mica industry.

Graphite

By Benjamin LeRoy Miller
Professor of Geology, Lehigh University, Bethlehem, Pa.

The fluctuations and instability of the graphite industry since 1916 were not in evidence during 1924. The industry seems to have become stabilized, but on a lower plane even than that of pre-war years. The demand for graphite crucibles has declined, as the electric furnaces have multiplied and other uses for graphite have not increased sufficiently to offset this decrease. The graphite business of the United States has largely passed into the hands of the importers and users of the foreign products, and there is no prospect, within the near future, of even reasonable prosperity for the domestic producer. In 1924 Madagascar and Ceylon dominated in the

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crystalline graphite trade, and Mexico and Korea largely supplied the demand for high-grade amorphous graphite.

The only company in Alabama that was in operation in 1924 was the Flaketown Graphite Co., at Mountain Creek, Coosa County. Nearly all of the thirty-five mills that were built before or during the war have been either burned or dismantled. Whether any of the Alabama plants can continue to compete with Madagascar flake is questionable, despite the relatively high import tariff. However, the increase in prices toward the close of 1924 furnished some encouragement.

The Southwestern Graphite Co., at Burnet, the only active company in Texas, operated during the first few months of the year and produced 558 tons of finished material. It closed down May 1, 1924. There was no activity in the New York, Pennsylvania, and Montana districts. Rhode Island continued to produce its limited amount of amorphous graphite, used mainly for foundry facings.

Three Canadian companies shipped 622 tons of graphite during the first half of 1924. This was mainly, if not entirely, old stock. The production of Mexican amorphous graphite was somewhat greater during 1924 than the preceding year. About 8,000 tons had been shipped up to Oct. 1, 1924.

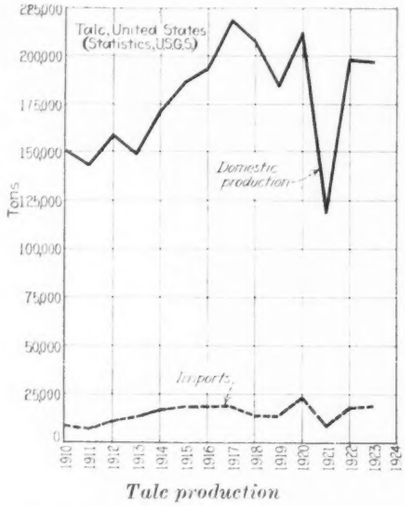
The graphite imports from Madagascar, Ceylon, and Korea were slightly less than during 1923, mainly on account of slackness in the crucible industry. The prices remained fairly constant until the close of the year, when they rapidly increased, owing to the exhaustion of accumulated wartime stocks, increase in marine freight rates, higher labor costs, and the rise in foreign exchange. During most of 1924, Ceylon lump sold in New York, after the payment of duty, for 5¼ to 6c.; chip, 4 to 4¾c.; and dust, 2½ to 3c. per pound. Early in December, 1924, prices had increased respectively to 7, 5½, and 4½c. Madagascar flake, which fluctuated between 4½ and 6c. until fall, increased to 8c. in December. Domestic flake prices were about the same as those of Madagascar. In general, Madagascar and American graphite flake are so nearly alike that they command practically the same price; although individual manufacturers continue to express decided preference for one or the other.

Talc

By Raymond B. Ladoo
General Manager, Southern Minerals Corporation, New York

Vermont and New York continue to be the largest talc-producing states, and dominate the industry, although their products are largely non-competitive owing to inherent differences in their physical properties. Probably the total Vermont talc production in 1924 was below that of 1923. At the end of the year business was good in most lines and the outlook was favorable for a good year in 1925. Prices in 1924 were a little higher than in 1923, but these are still low compared with costs and with pre-war levels. A further stiffening in prices, predicted for 1925, is necessary to provide an adequate return on capital invested and to restore conditions which prevailed before the period of severe price cutting in 1922-1923.

In the South there was little change in the talc situation, and probably the production, always small, was at least no greater in 1924 than in 1923. In the fibrous talc (asbestine, as it is known to the trade) district of northern New York, conditions were more favorable than in Vermont, and the 1924 production was probably equal to if not



Talc production

greater than that of 1923. Good business is also predicted for 1925. Prices in general remained firm during 1924 at the 1923 levels. There was some evidence of competitive price cutting by one producer, but these cuts were not met by the other producer, who has some advantage in the quality of his product. One new use for this kind of talc was developed—as a waterproofing agent in making concrete. The new application seems to have a promising future. By special milling methods one producer has been able to prepare a talc of special value as a high-grade paper filler. In the California talc districts the situation changed little from that prevailing in 1923. The production perhaps was a little larger and additional reserves were developed, but prices remained at 1923 levels and no new extensions of markets were apparent.

No other important developments occurred, although the usual number of new talc companies (which have not become producers) were incorporated. The talc industry in general, and that part of it which produces talc of the Vermont variety in particular, is still suffering from an excess of productive capacity and low prices. The too-low price levels have resulted from excessive competition and by misunderstanding of actual costs of production arising from lack of proper methods of cost accounting. This condition has caused the bankruptcy of many talc companies in the last few years and still exists in the industry. Even the larger and more efficient producers have been unable to earn profits, because of the very low price levels, and, what is more important, they have not even been able to maintain their properties in proper condition or to do the research and technical investigation which are now becoming so necessary.

Conditions seem to be improving, and it is to be hoped that no new productive capacity will be developed and no new price cutting wars started, so that the industry may have a chance to become stabilized on a thoroughly efficient and businesslike basis.

Tripoli

By G. V. B. Levings
Manager, American Tripoli Co., Seneca, Mo.

No new development of importance occurred in tripoli during 1924. Following the general market conditions of other materials, the demand and production of tripoli were somewhat less than in 1923—about 11,000 tons, compared with 12,000.

Exports continued to increase as conditions abroad became more settled, and are now close to pre-war figures, with excellent prospects for 1925. Hand-to-mouth buying by consumers was more noticeable in 1924 than during 1923, with the result that stocks in their hands were unusually low for December, indicating the probability of improvement during the early part of 1925.

Diatomite

By A. W. Allen
Assistant Editor, *Chemical & Metallurgical Engineering*, San Francisco

The diatomite mining industry showed strength in 1924 due to an expansion in the uses of this material. The Celite company produced about eight million sawn brick, for heat insulation purposes, from its Lompoc deposit in California. In addition large quantities of other forms of diatomite were marketed. The Feather Stone company acquired an extensive area near Lompoc and will exploit this concurrently with its Covina deposit. A pulverizing mill will be erected, together with classification apparatus and auxiliary equipment. It is also planned to saw brick from the material in place.

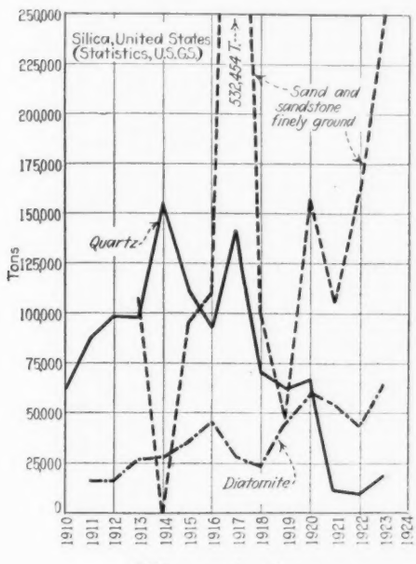
In addition to its recognized uses for heat insulation and as a filter aid, diatomite aggregate, with or without cement, is being widely applied as "sleeper fill," for deadening, in building construction. Research indicates a field for the fine diatomite product as a dehydrator and decolorizer of oils and as a filler for rubber goods. The most interesting development of the year was the starting of an oil recovery plant near Santa Maria, Calif., by the Continental State Products Co., in which petroleum-impregnated diatomite is used as raw material for the recovery of petroleum products by methods similar to those used in the treatment of oil shale. A market for the residues is expected to be developed.

Silica

By Hjalmar E. Skougor
Consulting Industrial Engineer, 149 Church St., New York

The industrial activity of 1924 reacted upon the silica business by stimulating production. A continuation of this condition appears to be assured.

The mining, preparation, and marketing of silica received particular attention from the U. S. Bureau of Mines, and during 1924 a study was made of the various methods used in the calcining, grinding, and pulverizing of flint, quartz, and silica sand, covering, also, mining methods, handling, blending, and loading of molding sand, as well as mining, washing, and cleaning of glass sand and of sand-blast and filter sand. Particular attention was given to the requirements of the consumers using these products. A report on sand-blast sand, its occurrence



Silica production

and preparation, has been written by W. Weigel, of the U. S. Bureau of Mines. Nine plants were visited in or about Mapleton and Mount Union, in Pennsylvania, and Berkeley Springs, in West Virginia.

A report on silica refractories in Pennsylvania was made by Prof. E. S. Moore, of the Pennsylvania State College, who calls particular attention to the changing of mining methods from floe rock quarrying to solid mining, and gives as the reason that the districts where floe rock quarrying was practiced are being rapidly depleted. Silica plant operators should avail themselves of the reports of these investigations, which are concerned with the betterment of their industry.

It is suggested that the silica producers should give serious attention to the building of non-metallic mineral mining and producing plants, so designed that these may supply the demands of the several neighboring manufacturing and building trades requiring feldspar, silica clays, fluorspar, and other minerals for ceramic enameling and similar purposes. Whenever lack of demand of one particular product becomes apparent another product which may be found in crude form within reasonable transportation distance can be utilized and will prevent a temporary closing down of the particular plant. An instance of this method of operation is a plant in California where not fewer than six different products can be produced as required by the demand, and a monthly output of 3,000 tons can be attained, the crude material being procured as far distant as Arizona.

It is difficult to estimate the future effect upon the mining and preparation of crude quartz by the recently perfected process for fusing quartz developed by E. R. Berry, of the Thompson Research Laboratory of the General Electric Co., until further developments have taken place upon a commercial scale, but it has promise of becoming an industry of great importance, and its progress should be awaited with considerable interest by the industry.

Two plants for the production of glass sand were constructed and started in operation during 1924 in Florida, and one plant in Missouri, each plant having a capacity of from fifty to seventy-five tons per day.

Kaolin

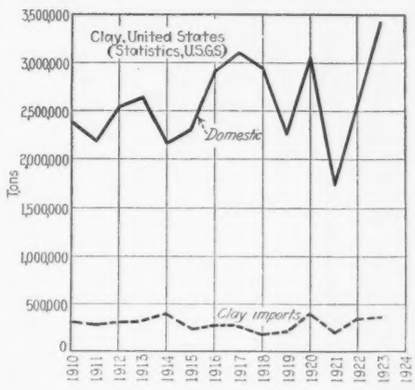
By R. T. Vanderbilt Co.
50 East 42d St., New York

Although shipments of china clay to the paper industry were somewhat slow during the early part of 1924, and shipments to the pottery trade were curtailed during September, October, and November, there is no doubt that the total volume of kaolin business during 1924 will far exceed that of 1923. Government statistics show that during the first nine months of 1924, 239,898 tons of china clay was imported, compared with 279,166 tons, the total imports for 1923. The domestic kaolin business has kept pace with that done in the imported clays, and it is safe to predict that the total consumption of domestic kaolin in the United States during 1924 has been in excess of 300,000 tons.

Not only has the china clay industry showed marked improvement in volume, but considerable activity in technical developments connected with its use has occurred. These have been chiefly in the pottery trade, where extensive experiments have been made in all branches of the white wares industry. In some instances, an all-American clay body is now being successfully manufactured. The average potter, however, has confined his tests principally to the problem of developing a body which would produce a better piece or decrease its cost of production, which is an urgent necessity because of the importation of large quantities of foreign pottery at a price less than the production cost in the United States. Tests have proved to the potter that he can use large quantities of domestic kaolins to good advantage.

The present indications point to the use of considerable quantities of kaolin in 1925 from South Carolina, North Carolina, Georgia, Florida, and the secondary kaolins, or ball clays, from the Poplar Bluff, Mo., district, in the pottery trade where little or no domestic china clay has been used in the past.

During 1924 an interesting event was the dissolution of the clay price-fixing association in England, resulting in



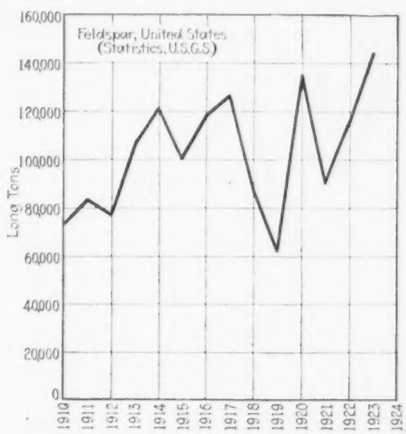
Clay production

open competition, and a consequently sharp decline in prices during the early fall. These reductions applied particularly to the imported grades of paper clay. It is understood that the association is being formed again and prices are expected to be stabilized upon a slightly lower basis than that which formerly ruled.

Feldspar

By Frank P. Knight
50 Congress St., Boston, Mass.

The outstanding features in the feldspar industry during 1924 were a marked expansion in mill capacity, a finer grinding of the finished product, an increase in cost of crude material, and a decrease in the selling price of the finished product.



Feldspar production

Quantities given herein are necessarily open to some degree of doubt, as complete data are nowhere available. It is, however, probably true that the erection of new grinding plants has increased the capacity for production by 75 per cent, and that additions to existing plants account for another 25 per cent, or a total of 100 per cent over that

of 1923. On the other hand, it is doubtful if consumption has increased 25 per cent. The situation therefore has resulted in a buyers' market. The grinders have been caught between the lower price for the finished product, due to competition in selling, and the increased price for crude material, which has been brought about by overbidding one another for it. Furthermore, production costs have been somewhat increased by the tendency toward finer grinding, which has become almost general.

If the U. S. Geological Survey's estimates of production for 1922, 117,127 tons, and for 1923, 140,700 tons, are accepted, by allowing an increase of 20 per cent in 1924, and imports of 35,000 tons, the available supply, including domestic production, was 203,840 long tons for 1924.

Supplies of crude at the mill were large at the time this article was written, and the assumption that supply exceeded consumption was therefore reasonable. Grinding capacity may be conservatively estimated at 350,000 tons per annum, or greatly in excess of the market requirements.

No new deposits of special importance have been discovered. In the treatment of feldspar the continuous grinding and air-separation process has become more firmly established. The industry is facing a period of readjustment, and there is great need for producers and grinders to get together for better understanding.

Barytes

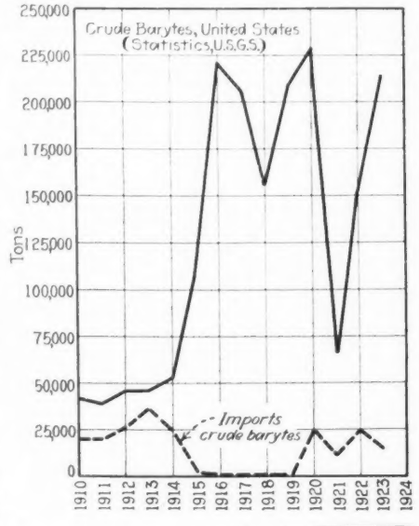
By S. W. Thompson

Thompson, Weinman & Co., Inc.,
101 Park Ave., New York

The position of the producers of barytes in the United States during 1924 has been more advantageous than in previous years in every way, for not only has better equipment for producing the crude material and satisfactory railroad service for the distribution of the product to the consumer been available, but competition from the foreign producers has been less keen. The position of the foreign producer in respect to the quality of this product and the quantity available is now rapidly changing in his favor. He is increasing his production and raising his standard to conform with pre-war requirements. However, this will not seriously interfere with American producers unless the tariff rate is lowered. This rate is now as low as any American producer can live under.

An important feature in the industry has been the steady demand by the domestic market during 1924. The market has widened, and there is a greater variety of uses into which barytes and its byproducts enter. No raw mineral product presents a more rapid expansion in variety of uses during the past ten years than does crude barytes. Barium is used in many chemicals, and consequently the domestic producers have had to raise their standard of quality by means of better machinery and more rigid chemical control.

The quantity of crude barytes used for pigments and in rubber manufacture has not materially increased, as there are several other inerts that are rapidly finding a place in the manufacture of rubber compounds and as constituents in paint manufacturers' formulas, thus diminishing the yearly tonnage of white, bleached barytes. This condition may be only temporary,



Barytes production

as many changes in the constituents of rubber compounds are made at all times, to the advantage of the raw-material men and the manufacturer who is under the necessity of adjusting his formulas to meet competition.

Barytes prices were normal in 1924, and about the same as in 1923. They receded slightly during the last half of 1924. As present production and prices are balanced, there is no possibility of lower prices from a production standpoint. There is no reason, in my opinion, why the barium industry, both in crude barytes and finished products, should not have a prosperous year during 1925.

[Production of crude barytes was, according to the U. S. Geological Survey, 214,183 short tons in 1923; imports were 15,045 tons; average mine value of crude was $7.77 per ton; and the average declared value of imports, $6.23 per ton.]

Gypsum

By Frank A. Wilder

President, Southern Gypsum Co.,
North Holston, Va.

When the figures for the 1924 production of gypsum are compiled they will be larger than those of any preceding year. It is hardly probable that the remarkable increase made in 1923 will be duplicated. In that year there was a gain of 26 per cent in the output of gypsum. A gain of 12 per cent over 1923, when the output reached 4,753,448 tons, seems a safe prediction for 1924. Such an estimate is in harmony with the increase in the number of building permits for 1924.

Crude gypsum used as retarder for portland cement doubtless increased at least in like proportion. Because of the amount of cement used in road construction, the increase in crude gypsum sold to cement mills was probably greater in 1924 than the increase in the amount utilized in calcined products. It will not be surprising, therefore, if the total output of gypsum for 1924 shows a gain of 15 per cent when compared with any earlier year.

The growth of the gypsum wallboard industry is the outstanding feature of 1924. The advantages of a fabricated board for certain types of construction and special conditions had been demonstrated by the extensive use of fiber boards bearing various trade names. As soon as a successful mineral composition board was offered to the trade, its advantages were at once appreciated. Ability to retard fire, together with freedom from buckling and warping, quickly gave wall boards with a gypsum core a controlling position in this special field.

The increasing utilization of gypsum wall board has not measurably reduced the demand for gypsum plasters, as it generally enters into phases of building construction wherein plaster would not be used. Gypsum wall board of superior quality is now produced in large quantities by several gypsum companies; and smaller amounts are fabricated by concerns that buy their calcined gypsum from gypsum manufacturers.

Magnesite

By George J. Young

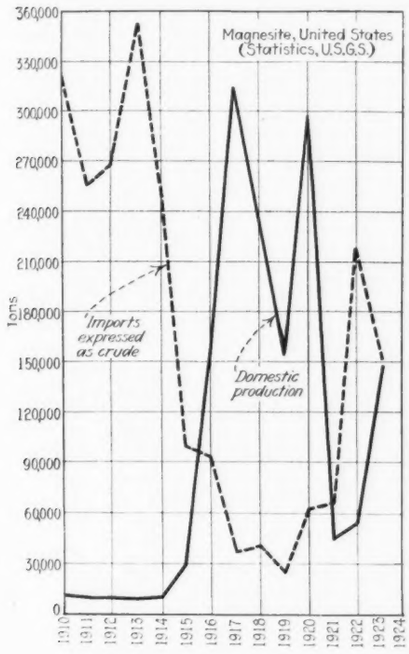
Associate Editor, *Mining Journal-Press*

Both California and Washington production of crude magnesite in 1924 will be less than that for 1923, which was 147,250 tons. Prices have been if anything lower than those prevailing in 1923, although quotations showed a slight increase in calcined ground and were unchanged in dead-burned and Grecian caustic calcined. Without doubt prices were considerably shaded below the quotations in the latter part of the year.

Imports for the first nine months of 1924 were 51,142 tons dead-burned and 10,987 tons caustic calcined. The estimate for the year from these figures is 68,184 tons dead-burned and 14,652 tons of caustic calcined, or a total of 82,836 tons of both grades. No crude magnesite was imported. The imports in 1923 were 5,182 tons of crude and 72,955 tons of calcined, not purified (which includes dead-burned and caustic). The 1924 estimated importations are equivalent to 165,672 tons of crude magnesite, against 151,092 tons equivalent in 1923. Thus the year indicates a falling off in domestic production and a gain in foreign importations equivalent to 14,580 tons of crude magnesite.

A concession in rail rates during 1924 was given to California producers, which enables them to reach the Chicago territory for $10 per ton. Shipment to New York via the southern route is $10 per ton. Via Panama the rate is $6 to $8 per ton. In spite of the freight concession, the position of

domestic producers in California and Washington has not been greatly improved. The market in California for magnesite products fell off somewhat in 1924, due to a business slump in Los Angeles. The local market is not broad enough, and mid-continent and Eastern markets must absorb a part of the production to make California producers prosperous. Grecian and Indian



Magnesite production

magnesite compete heavily in these markets.

An increase in the prevailing tariff is indicated as being highly desirable from the viewpoint of domestic producers generally. Even if the maximum increase were allowed, which would bring the tariff rate to $18.75 per ton, producers would not have much margin for profitable operation. Lower freight rates would help the situation materially.

Fluorspar

By G. H. Jones

President, Hillside Fluorspar Mines, Chicago, Ill.

No profit was made in 1924 by the fluorspar industry as a whole, which fact was partly due to a small demand on account of the long-continued depression in the steel business, and partly because of the apparently forced liquidation of large stocks of concentrated fluorspar held above ground by two of the large mines. These stocks have been a menace to the market for two years, and are being sold at less than the cost of production by the mines, which are operated below water level under conditions requiring the handling of large quantities of water. Foreign fluorspar arriving in increasing quantities has supplied the eastern steel makers, and, when the reports for 1924 are available, they will probably show the largest tonnage imported during any one year.

The La Fayette Fluor Spar Co., a subsidiary of the U. S. Steel Corporation, in its Kentucky group of mines near Mexico, Ky., is as yet making only a small production, but is doing much development and construction with good prospects of a fair output during 1925.

The Franklin Fluorspar Co., a subsidiary of the Aluminum Ore Co., on Nov. 17, 1924, bought the properties of the Fairview Fluorspar & Lead Co. in both Illinois and Kentucky, and prior to that date, the Hamp mine, in Illinois, as well as about fifteen other mines and prospects in Kentucky. Whatever the Franklin company's plans may ultimately be, the company will be an important factor in the industry, although it may not have much surplus tonnage to market.

The Hillside Fluorspar Mines has acquired the Keystone mine, about six miles west of Marion, Ky., and expects to place it in production in the spring of 1925. This will give the company three producing mines. It was one of the largest producers in 1924.

New tonnage mined and concentrated in the United States during 1924, when all reports are in, will show one of the leanest years since 1905. The domestic tonnage for 1924 will be much below normal, as the main shafts of two of the largest producers that are now drowned out will not be unwatered.

Prices have gone as low as $18 per ton, f.o.b. mines, for washed gravel, guaranteed analysis. Probably 90 per cent of the domestic production came from the Illinois-Kentucky field, and 80 to 85 per cent went to the steel companies for use as a flux in basic open-hearth furnaces. An advance of several dollars per ton may be anticipated, but not before spring, as buyers are well supplied for the winter. The low prices current during the last half of 1924 cannot be continued if the large properly equipped mines are to survive. The changed conditions in ownership will leave not more than three or four dependable domestic sources of fluorspar supply, and these will have only a limited output.

Phosphate Rock

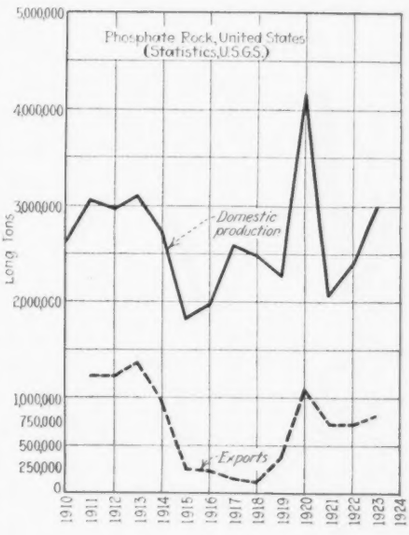
By H. D. Ruhm

Mount Pleasant, Tenn.

Owing to the fact that there is now about 50 per cent greater producing capacity than the present demand for phosphate rock would appear to warrant, the domestic industry is depressed. Practically the same condition existed in 1915 after the war had cut off the European demand. However, domestic demand increased during the war, so that by the end of 1918 it had almost made up for the loss of the European market. The European market revived in 1919, and the increase in demand created by both markets was the largest in the history of the industry. This continued during 1919 and 1920 and resulted in a great increase in producing capacity, practically all of which was in the Florida field. A small increase of producing capacity took place in Tennessee. By the end of 1920, when economic readjustment had been in some degree effected, domestic demand fell away and the profitable export trade dwindled.

Domestic demand has now increased, but the European market situation is completely altered by the French development in Morocco and the English operations on Ocean, Christmas, and other Pacific islands. As a result of foreign developments there is little or no hope of doing any future profitable export business.

When the large fertilizer companies during the pre-war period began to mine their own phosphate rock, their mines were developed for enormous tonnages to cut down the cost of production. They sold their surplus production to Europe and to their domestic competitors, who manufactured it into acid phosphate. These companies



Phosphate rock production

created such unwieldy overhead and fixed charges that cannot now be absorbed, and stimulated the organization of such a large number of smaller competing companies, that they are now in a deplorable condition. The bulk of the domestic and all of the foreign phosphate demand is for fertilizer manufacture, and, as the greater part of the fertilizer industry of this country is in the Southeastern states, the greatest development has been in Florida. Tennessee has been left only the market for the interior fertilizer manufacturers, the furnace trade, and the few consumers of raw ground rock for direct use on the soil. In their present extremity for business, the Florida producers have reached out as far as Chicago and St. Louis, although the freight excess to this territory is $4 per ton. In spite of this handicap, Tennessee produced in 1924 about 300,000 tons, or more than 45 per cent of the maximum annual production.

The greatest possibility of increased consumption of phosphate rock is in the development of the raw ground rock market. This potential increase is in the cotton country tributary to Tennessee. The large miners of Florida rock will obviously discontinue taking

business at a loss. Financial reorganization will probably take place during 1925. A return to normal conditions will result in a smaller production from Tennessee and the Far Western states, but Florida may be expected to produce far more than all of the other states. Most of the prospective developments in producing acid phosphate, phosphoric acids, and phosphorous compounds are being worked out in connection with Tennessee rock, as it seems chemically constituted to yield best to heat treatment, and cheaper power along the Tennessee River is an important possibility. The blue rock in Tennessee, long overshadowed by the more cheaply mined and higher-grade brown rock, will have a chance for development under improved power conditions.

[Phosphate rock was produced in Florida in 1924 to the approximate amount of 2,650,000 tons; in Idaho, 35,000 tons; total including Tennessee, 2,985,000 tons.]

Nitrate

By Huntington Adams

Mining Engineer, 522 Fifth Ave., New York

The nitrate industry of Chile steadily improved its position during 1924. Production and exports have now reached approximately the average of the pre-war period, or 2,500,000 metric tons per annum. The value of this production is about equal to that of all the other mineral products of South America taken together.

In 1923 the United States imported 998,000 metric tons, the value of which was exceeded only by that of the tin and diamonds among the net imports of all mineral products to this country. Production in Chile averaged 195,000 tons per month during the first nine months of 1924, against 132,000 tons per month during the same period of 1923; exports from Chile averaged 182,000 tons per month, against 166,000 tons in 1923 (production commonly exceeds exports during the first three quarters of the year).

Stocks of nitrate unsold, including those in Chile, Europe, and, afloat, amounted to 1,363,500 metric tons on Oct. 1, 1924, against 1,410,000 tons on Oct. 1, 1923. The sale price of nitrate in the Chilean market is still controlled by the Nitrate Producers' Association, and therefore does not reflect the direct effects of competitive demand. The price was maintained at 21s. per metric quintal, f.a.s. Chilean ports, up to June 1, 1924, and at 20s. 10d. from June 1 to Nov. 1, 1924. These prices are equivalent respectively to $45.40 and $46.80, United States currency, per metric ton at the average rates of exchange. The average price of the pre-war period was equivalent to $40.80 per metric ton.

The most notable development of 1924 was the entry of Guggenheim Bros., of New York, into the nitrate industry. Through the South American Products Co., which they control, they purchased the Coya grounds from the Chilean Government at the public auction held on Sept. 15, 1924. This property is in the Toco district. It has an area of 81.084 square kilometers (approximately 20,000 acres) and is estimated by the Chilean Government engineers to contain about 20,000,000 tons of caliche (nitrate ore) of an average content of 21.6 per cent nitrate, capable of producing a total of 2,400,000 metric tons of commercial nitrate. The price paid was equivalent to $3,420,000, United States currency. Government nitrate lands are sold at auction, on the basis of the estimates of government engineers, a minimum bidding price being fixed beforehand by the government.

Late in December, announcement was made of the purchase by Guggenheim Bros. of the Anglo-Chilean Nitrate and Railways Company's properties, consisting of extensive grounds, three nitrate works (Oficinas Coya, Peregrina and Santa Isabel) of aggregate annual capacity of about 135,000 tons of nitrate and a 100-mile, narrow-gage railroad connecting the port of Tocopilla to the ten nitrate works in the Toco district. The investments of the Guggenheim Bros. in the nitrate industry, which amount to approximately $20,000,000, will make their holdings the most important in the Toco district.

Potash

By Charles H. MacDowell

President Armour Fertilizer Works, Chicago, Ill.

American potash consumption in 1924 for the first time equaled the pre-war figures. A study of the grades consumed, however, shows a marked change. During 1913, 465,000 tons of kainit (12.4 per cent potassium oxide) was imported, and the 1924 quantity will amount to about 130,000 tons. Before the war kainit was bought to a large extent by the farmers for direct application to the soil. In 1924 the same amount of potash was used, but was bought in the form of mixed fertilizers. A comparison of the number of units of potash in 1924 complete fertilizer formulas with those of 1913 shows an increase of nearly 1 per cent potassium oxide, or 25 per cent of the potash used.

Potash production in 1924, only eighty of the two hundred German mines being in operation, exceeded the world's consumption. The twenty Alsatian mines alone could easily take care of American requirements. United States production amounted to one-ninth of domestic consumption.

Prices in 1924 were lower than in 1913, in spite of higher transportation costs. This was due primarily to competition between the Germans and the French. In August the German and French mines agreed upon a three-year working arrangement, allocating the United States business on a basis of German mines 62½ per cent and French mines 37½ per cent. This may result in higher prices later. A deterrent, however, exists in the excellent condition of the one domestic potash plant in California, which in spite of cheaper prices has managed to thrive and is in a position to furnish an excellent quality and in increasing quantities.

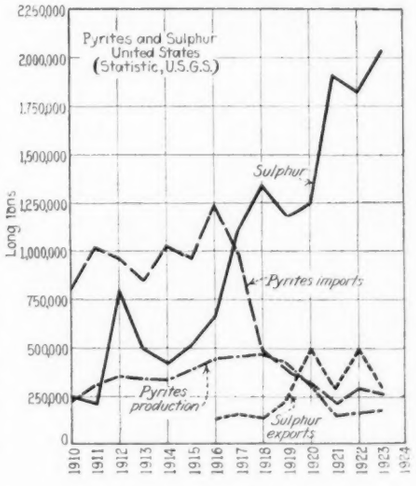
Sulphur and Pyrites

By Dr. Raymond F. Bacon

Chemical Engineer, Chemists' Building, 50 East 41st St., New York

The world situation on sulphur during 1924 did not differ materially from that for 1923. Again three companies in the United States produced and sold the bulk of the world's consumption. The three companies are the Texas Gulf Sulphur Co., the Union Sulphur Co., and the Freeport Sulphur Co. In addition to the United States output, Italy produced during the year about 180,000 tons, and Japan about 30,000 tons, the latter supplying only her own market. The world's market outside of the United States was stabilized through an agreement between the Italian Government and the Sulphur Export Corporation, which comprises the three American companies. This agreement allocates to the Italians the sale of 200,000 tons of sulphur and fixes the price in all countries except the United States.

The total world's consumption during 1924 was about 1,750,000 tons and the production of the United States was about 1,300,000 tons. Stocks on hand, which at the end of 1923 were reported to be 2,900,000 tons, probably decreased during the year to the extent of from



Sulphur and pyrites production

300,000 to 400,000 tons. The distribution of sulphur in the several consuming industries was about as follows: Fertilizer, 30 per cent; acid and chemicals, 34 per cent; explosives, 5 per cent; paper and pulp, 24 per cent, and miscellaneous industries, 7 per cent.

The fertilizer industry was badly disorganized by unprofitable competition in the early months of 1924, and the failure of one of the largest manufacturing companies had a profound effect. At the end of the season fertilizer manufacturers realized the necessity of moving with caution on another year's work, and many plants closed during summer months. The first of September recorded a revival of manufacturing activities, and all companies appear to be moving with more confidence. The fertilizer industry as a whole fell

off between 10 and 15 per cent in operations, as compared with 1923, but the outlook for 1925 is bright.

The acid and chemical industry, in spite of disastrous competition on sulphuric acid and heavy chemicals in general, operated at about the same rate in 1924 as in 1923. The explosives industry fell off as much as 20 per cent in its demand for sulphur during the last year. The pulp industry, though feeling foreign competition keenly, continued its operations in 1924 at practically the 1923 rate; in some instances this was due to stocking of warehouses with pulp ready for paper manufacture when demand and prices justified. Many new sulphite pulp projects are reported on the Pacific Coast and in Canada. With a steady growth in demand for pulp and paper products, manufacture of the two must increase, and the only possible point for expansion is in Canada, which will be reflected in increased export sales of sulphur. Production of lime sulphur and sulphur for dusting was seriously affected by the condition of the farmers in the fruit-growing districts. Grinders and refiners have felt the decrease in operations of rubber and wire manufacturers.

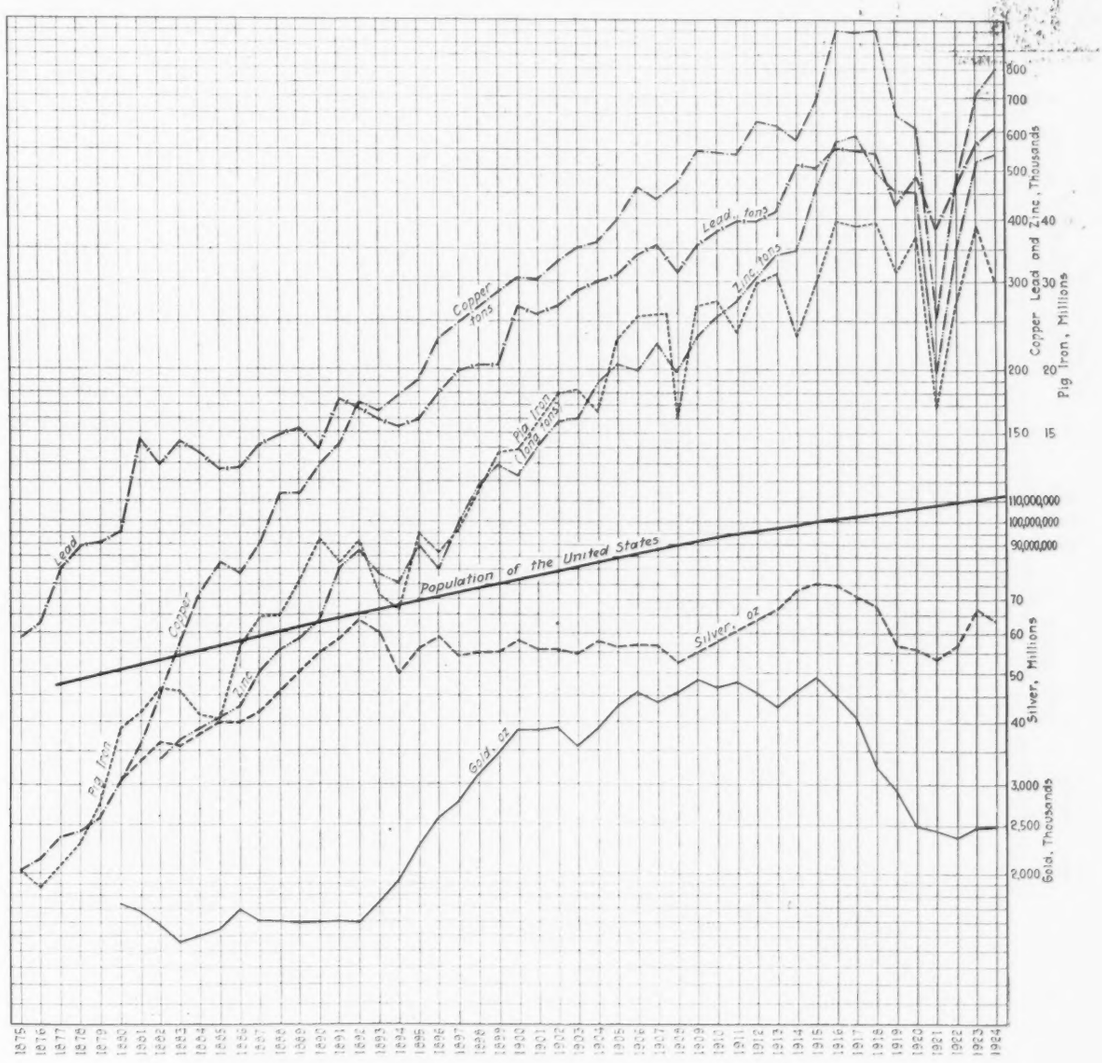
The sulphur business as a whole will perhaps show a decrease of 10 per cent in 1924. With general business expanding, the future looks bright for this industry. Respecting individual companies, the last financial statement of the Freeport Sulphur Co., showing a deficit for the previous three months, indicates that the operations of that company at its Hoskins Mound property have not been as successful as expected. At the date this article is written, rumors are current that the Union Sulphur Co. will cease operations on Dec. 31, 1924, at its famous mine in Calcieu Parish, La.

Pyrites imports into the United States during 1924 were approximately 240,000 to 250,000 tons, a slight decrease from the imports of 1923. Domestic production of pyrites was approximately the same as in 1923, being about 180,000 to 190,000 tons, most of which came from Virginia and California. The price of pyrites during the year was stable. Present indications are that there will not be much change in the pyrites situation during 1925.

Borax

Editorial Summary

During 1924, no new borax deposits were opened, although in the latter part of the year several drilling campaigns were started by independents. Three important interests dominate the borax mining industry, the Pacific Coast Borax Co., which markets about one-half of the refined borax output; the American Trona Co., and the West End Chemical Co., the latter two companies dividing a considerable proportion of the remaining production about equally. The Suckow Chemical Co. operates a borax mine at Muroc, Calif. The American Borax Co. ceased operating its property, although exploration work is being done. The West End Chemical Co. added a second kiln to its Las Vegas plant and doubled its output capacity. American Trona produced more borax in 1924 than in 1923. Late in the year its borax output was increased 50 per cent. The Pacific Coast Borax Co. has started its new plant at San Pedro, Calif. The industry is in a healthy state, but competition is keen.



Metal Production in the United States—1875-1924

TECHNICAL DEVELOPMENTS

Mining Geology

Numerous and Varied Contributions Show Broad Interest

By J. Volney Lewis
Professor of Geology, Rutgers University,
State University of New Jersey, New Brunswick, N. J.

J. Volney Lewis

THE touchstone of scientific theory is prophecy. In mining geology this means the ability to discover new deposits—an increasingly difficult feat. Geologic knowledge long followed rather than led discovery, but, nevertheless, a fund of knowledge accumulated, from which some of the principles of ore deposition are now being formulated. Such principles must be relied upon in the future more and more in the search for hidden deposits, whether they are metalliferous or non-metallic.

It is yet too early to appraise the value and influence of Spurr's "Ore Magmas"; but it has received an open-minded welcome in its first year, notwithstanding its rejection of cherished theories and its advocacy of views quite at variance with them. Further evidence of this wholesome frame of mind among recognized leaders of the science is found in such frank utterances as Ransome's editorial on "Science and Dogma."[1] So long as this spirit reigns, progress is assured, whatever theories stand or fall.

Contributions on General Principles

Only through the understanding of fundamental principles can geology aid the mining industry. The processes that give rise to deposits of useful minerals and those that modify them lie at the very foundation. Many monographs, bulletins, and shorter papers that appeared during 1924 make distinct contributions to the subject here discussed. Some of these are noted in this paper, but no attempt has been made to compile a bibliography.

Rastall's treatise on ore deposits[2] is well written, thoughtful, and advanced, embracing the theory of the zonal distribution of ores and the direct magmatic origin of many gold-quartz veins. Particularly notable is the discussion of origin. Professor Kemp has set forth clearly in *Economic Geology* the new emphasis on the pegmatites in connection with a wide range of mineralization. Downward changes in ore deposits, toward a deeper source, have been discussed by Emmons,[3] who finds gaps, or barren belts, in the sequence. He also considers magmatic differentiation and the resulting distribution of metallized areas. The relations of Canadian ore deposits to the Pre-Cambrian igneous intrusions are discussed by Baker,[4] who points out the importance of geological investigation in the great unexplored areas. Corless[5] also writes on the mineral wealth of this region and gives credit to geology for guiding discovery and development.

Geologists are realizing more acutely the need for preserving mining records and for making available the stores of information locked up (and eventually lost) in the archives of many corporations.

Vigorous papers by Brock[6] and White[7] urge continuous study of the geology during the progress of mining, for guidance in future prospecting and development. Chiefly descriptive is an outline of the economic geology of Tasmania by Hills[8] and a monograph on the mining districts and mineral resources of Nevada by Lincoln.[9]

Growing Importance of Research in Prospecting Shown by Many Articles

With the progressively increasing difficulty and expense of finding new deposits, the geologist has sought aid from many other branches of science. Encouraging progress in the study of leached croppings by chemical methods has been described by Morse and Locke,[10] and, with the aid of the binocular microscope, by White,[11] who has applied the method successfully to the search for new orebodies. White[12] has also developed flame tests for the detection and estimation of copper in leached croppings, which he finds seldom lose all traces of the metal if it was originally present. Methods for utilizing the magnetic and electrical properties of minerals in prospecting have been more widely employed than heretofore, and much has been learned respecting their particular fields of usefulness, as well as their limitations. Fortunately, the various methods are in a measure supplementary, so that where one fails another may succeed.[13] The possibilities of prospecting from the air have been discussed by Webb[14] and Mackenzie,[15] and graphic methods of

[1] *Econ. Geol.*, Vol. 19, pp. 205-208.
[2] "The Geology of the Metalliferous Deposits." R. H. Rastall. Cambridge University Press, Cambridge, England, 1924.
[3] *Min. & Met.*, Vol. 5, pp. 245, 246 (abs.)
[4] *Can. Min. Jnl.*, Vol. 45, pp. 1121-1123.
[5] Can. Min. Inst., Toronto meeting, March 8, 1924.
[6] "Scientific Ore Finding," *Econ. Geol.*, Vol. 19, pp. 674-676 (Nov., 1924).
[7] "Advantages of Permanent Geologic Records," *Min. & Met.*, Vol. 5, p. 65 (Feb., 1924).
[8] *Proc.* Austr. Inst. Min. & Met., No. 52, pp. 129-147.
[9] Nevada Newsletter Pub. Co., Reno, 1923.
[10] *Econ. Geol.*, Vol. 19, pp. 249-258.
[11] *Mining Journal-Press*, Vol. 117, pp. 483-488.
[12] *Mining Journal-Press*, Vol. 117, pp. 568, 569.
[13] "Magnetic Determination of Oil and Salt." J. Koenigsberger. Pet. Zeitschr., Vol. 20, pp. 227-229; also Kall, Vol. 18, pp. 57-59. "Practical Experience in Electrical Prospecting." Hans Lundberg. Swed. Geol. Surv., Ser. C, No. 39 (March, 1924). (Abs. *Mining Journal-Press*, April 5, 1924.) "Electrical Prospecting in Sweden, an Achievement." *Mining Journal-Press*, Vol. 117, p. 174. "Electrical Prospecting in Canada." S. F. Kelly. *Bull.* Can. Min. Inst. No. 143, pp. 166-187; No. 145, pp. 342-248. "Prospecting by Radio." Wilbur C. Riley. *Mining Journal-Press*, Vol. 118, pp. 733, 734.
[14] *Min. Mag.*, Vol. 30, pp. 217, 218.
[15] *Bull.* Can. Inst. Min. & Met., Oct., 1924, pp. 675-706.

combining drill-hole data and geologic deductions have been proposed by Harding.[16] If the reflecting microscope is to live up to its high promise as a geological tool, declares Gilbert,[17] more definite standards of interpretation must be developed. Great difficulty and uncertainty of interpretation of its results was also encountered by Buddington.[18] Geophysical aids, particularly the seismograph and the differential gravity (torsion) balance, were more widely used in 1924, especially in the petroleum regions of Mexico, the Gulf Coast, and the Midcontinent.[19] A degree of success has been achieved in the location of salt domes on the Gulf Coast. In petroleum geology also refined methods of sampling and correlation have been applied more extensively and intensively than ever before. These include core-sampling, the use of micro-fossils, heavy minerals, and composition of underground waters. The rôle of intersecting fracture zones in the localization of mineral deposits and their value as an aid in prospecting are emphasized by Porter,[20] who cites pre-mineral cross-fracturing as a forerunner of ore deposition in many regions.

Magmatic Injection of Gold-Quartz Veins a Feature of the Literature

Direct magmatic injection as a source of many gold-quartz veins is a notable feature of the literature. A realization of the genetic relationship between the porphyry and the ore has stimulated exploration throughout the Porcupine district, says Robinson,[21] in a paper on the geology of the Pearl Lake area. He predicts the discovery of other orebodies if exploration is only guided by the peculiarities of the structure. The Porcupine field has also been studied by Fielding[22] and its extension into Quebec by Wright and Segsworth.[23]

The geology gives warrant for further development in several areas in the Idaho batholith, as described by Thomson,[24] where gold-quartz veins are closely associated with dikes of pegmatite, aplite, and lamprophyre. The classic Grass Valley district of California has lately been studied by Howe,[25] who concludes that the quartz veins are largely replacements. In discussion Spurr points out the possibility that the replacement might have been effected by an injected silica magma, and he considers the conditions consistent with such an origin.

Operators at Cobalt, Ont., have had constantly the advantage of excellent geological information from the Ontario Bureau of Mines, and the most successful operators are those who have closely followed the geological features of their problems. This is the opinion of Cole,[26] who discusses the geology of the Cobalt district. The conditions governing the oreshoots, which should guide in exploration and development, are emphasized by Bell[27] in his description of the geology of the South Lorrain district.

Formerly little geologic work was done in the Tintic district, Utah; but conditions are now being reversed, and geologic investigations are considered of great importance, says Havenor,[28] particularly in working out the structure and locating the beds that have been found productive. Budelman[29] finds in the geology of Tonopah, Nev., the possibility of discovering downward and eastward extensions of veins that have been cut off by faults or intrusives. He regards the monograph by Spurr as "a shining example of real aid on the part of the Geological Survey to the industry." An encouragement to further exploration is also found by Bastin[30] in his conclusion that the rich ruby silver ores of the Cerbat Mountains, Arizona, are primary, and hence probably continue in depth.

Origin of Lead and Zinc Deposits In Upper Mississippi Valley

That both fissures and ores probably bear a relation to underlying intrusive igneous rocks is Spurr's[31] conclusion as to the origin of the lead and zinc deposits of the upper Mississippi Valley. Concerning the earlier conflicting theories he finds that "for each theory proposed the objections seem stronger than the affirmative arguments." On the other hand Spurr[32] finds the zinc deposits at Edwards, N. Y., attributable to direct injection of ore magma after a thorough soaking of the strata with pegmatite magma.

Interesting possibilities of new orebodies are found by Rickard[33] from a study of the geology of the Ahumada lead mine, in Chihuahua, Mexico, where the deposits have been localized by replacement of limestone at favorable intersections of fissures. Values fail below 1,500 to 2,000 ft. in the quartz-argentite veins of the famous Pachuca mine, Mexico. As described by Burwell,[34] the veins impregnate and replace shattered zones in andesite. An exhaustive monograph on the famous Broken Hill district, in New South Wales, by Andrews,[35] is a storehouse of valuable information. Ores of silver, lead, zinc, copper, magnetite, tin, and tungsten are associated with pegmatite in zones of intense metamorphism adjoining intrusive granite. In the Transvaal, persistence of galena at the surface, an enriched carbonate zone, a barren leached zone, and oxidation deep below the ground-water level are remarkable features of silver-lead ores 50 miles east of Johannesburg, as described by Wagner.[36] The sequence of events in deposition and the zonal arrangement of orebodies in relation to the monzonite at Bingham, Utah, are clearly described in valuable papers by Winchell, Hunt, and Peterson.[37]

Valuable discussion of secondary enrichment centered around the reports of investigations under the direction of Prof. L. C. Graton[38] and financed by leading copper companies. These papers and the discussion that followed will form a volume on secondary enrich-

[16] *Mining Journal-Press*, Vol. 117, pp. 767-770.
[17] *Econ. Geol.*, Vol. 19, pp. 668-673.
[18] *Econ. Geol.*, Vol. 19, pp. 521-541.
[19] "Geophysical Prospecting Methods in Mining." G. Glockemeier. Metall. u. Erz., Vol. 21, pp. 165-173; pp. 189-202. "Seismographic Search of Rock Formations." C. E. Kern. *Oil & Gas Jnl.*, Vol. 23, p. 21; pp. 126-129. "Determination of Salt Domes With the Eötvös Torsion Balance." J. Koenigsberger, Petr. Zeitschr., Vol. 20, pp. 723-725. "Eötvös Torsion Balance." Editorial *Econ. Geol.*, Vol. 19, pp. 84-86. Numerous descriptive articles in petroleum journals.
[20] *Mining Journal-Press*, Vol. 118, pp. 650-652.
[21] *Econ. Geol.*, Vol. 18, pp. 753-771.
[22] *Bull.* Inst. Min. & Met., No. 231; No. 232, pp. 9-20; No. 236, pp. 21-25.
[23] *Mining Journal-Press*, Vol. 117, pp. 763, 764.
[24] Idaho Bur. Mines & Geol., *Bull.* 7, 1924; *Mining Journal-Press*, Vol. 118, p. 533.
[25] *Econ. Geol.*, Vol. 19, pp. 598-622.
[26] *Mining Journal-Press*, Vol. 118, pp. 325-330.
[27] *Min. & Met.*, Vol. 5, p. 33 (abs.).
[28] *Mining Journal-Press*, Vol. 117, pp. 355-361.
[29] *Idem.*, Vol. 118, p. 5.
[30] U. S. Geol. Surv. *Bull.* 750-B, 1924.
[31] *Mining Journal-Press*, Vol. 117, pp. 246-250; pp. 287 292.
[32] *Idem.*, Vol. 117, pp. 684-689.
[33] *Mining Journal-Press*, Vol. 118, pp. 365-373
[34] *Idem.*, Vol. 118, pp. 725-730.
[35] *Mem.* Geol. Surv. N. S. W., "Geology, No. 8," 1922; "Supplement," 1923.
[36] *Econ. Geol.*, Vol. 19, pp. 651-667.
[37] A.I.M.E., February meeting, New York, 1924.
[38] A.I.M.E., February meeting, New York, 1924.

ment that will take its place along with the classic volumes on ore deposits by Posepny and Emmons. White[39] has discussed an interesting zone of enrichment below lean sulphides in the Cananea district. Replacement, not gravity segregation, is the conclusion of Wandke and Hoffman[40] as to the origin of the Sudbury ores, in Ontario, and hence the deposits may be expected to persist to considerable depth. Lenticular pyritic ore in schists at the Hitachi mines, one of the most important types in Japan, is an end product of differentiation in a granodiorite magma, according to Watanabe and Landwehr.[41] Search for barren hills or open spaces in bush-covered country located most of the copper deposits thus far discovered in the Congo, according to Wheeler;[42] but they are not limited to such places. The orebodies are chiefly shallow malachite replacements of dolomite.

In the Ray Folio, Ransome[43] presents an excellent treatise on the geology and ore deposits of the Ray district, in Arizona. Valuable discussions of origin, structure, and distribution are included in many other papers.

Advances in Geology of Iron Ore Deposits—Clinton Ores Originally Carbonate

The Clinton hematite ore was originally carbonate, at least in part, at the Irondale mine, Wise County, Va., according to Stose,[44] who thinks, however, that most of the Clinton ores were originally deposited as oxide. The magnetite deposits of eastern Porto Rico are interpreted by Fettke[45] as contact metamorphic replacements of limestone and calcareous tuffs. The magnetite slates of the Cuyuna range, in Minnesota, are described by Thiel,[46] who also discusses the possibility of magnetic concentration.

The famous Langban iron mines of Sweden represent a unique type, and the problem of origin is one of exceptional difficulty. Magnusson[47] finds that originally iron and manganese, sharply separate, formed shallow replacements of dolomite. Later metamorphism produced zones of many silicates, including remarkable "fissure minerals."

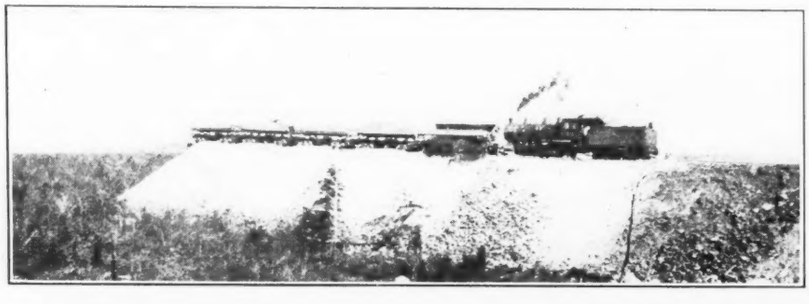
A remarkable platinum-quartz lode, a mile and a half long, occupies a fault zone in felsites and sandstone, 20 miles northeast of Johannesburg, South Africa. Wagner and Trevor[48] find a considerable part of the lode workable. Van der Veen[49] finds diabase accompanying the famous cinnabar deposits of Almaden, Spain, where the existence of igneous rocks has heretofore been doubted. The tungsten ore of the Tavoy district, Burma, occurs with tin in quartz veins associated with pegmatite and feldspar porphyry —all regarded by Brown and Heron[50] as offshoots of contiguous granite. Molybdenite segregations occur in a pegmatitic facies of Pre-Cambrian syenite in the Amprior-Quyon and Manawaki areas of Ontario and Quebec.[51]

Along with the expansion of mining in several of the non-metallic fields there is a growing tendency to inquire into their geologic relations, and valuable results in the form of monographs and reports appear among the notable publications of 1924. Many of the problems are similar to those in other fields of mining, and pleas for the application of geological and engineering methods have been made by Parsons[52] and Rockwood.[53] Minable gypsum beds result from unusual conditions, according to Wilder,[54] who is the author of an exhaustive monograph on this mineral. The hypothesis of marine evaporation is rejected, and the Fort Dodge deposits in Iowa are ascribed to gypsum-rich drainage into a restricted basin. Kentucky fluorspar deposits have arisen from deep-seated basic magma, and deep mineralization is probable, in the opinion of Currier.[55]

Magnesite deposits are ascribed by Bain[56] chiefly to replacement of limestone by magnesium-bearing magmatic waters and alteration of serpentine by carbonated magmatic waters. The great borax deposits of California and Nevada are old playa deposits, according to Foshag.[57] Intense volcanic activity furnished the boron. Geological examination and exploration of quarry properties and their relation to financing has been discussed by Rush;[58] and the geology and origin of sand and gravel deposits by Dake.[59] Gordon, Dale, and Bowles[60] describe the geology and technology of the extensive marble deposits of East Tennessee. Contributions to the geology of phosphate deposits come from the Mansfield district, Victoria,[61] and from Tennessee.[62] The geology, origin, and occurrence of carbons (drill diamonds) are discussed by Garrison,[63] who emphasizes the slender supply and the need for modern methods of exploration and mining.

[39] *Econ. Geol.*, Vol. 19, pp. 724-729.
[40] *Idem.*, Vol. 19, pp. 169-204.
[41] *Idem.*, Vol. 19, pp. 434-454.
[42] *Min. & Met.*, Vol. 5, pp. 55-59.
[43] U. S. Geol. Surv. Folio No. 217, 1924.
[44] *Econ. Geol.*, Vol. 19, pp. 405-411.
[45] *Min. & Met.*, Vol. 5, pp. 195, 196.
[46] *Mining Journal-Press*. Vol. 118, pp. 735-738.
[47] Geol. Fören. i. Stockholm Förhandl., 1924, pp. 284-300.
[48] *South African Journal of Industries*, Dec., 1923.
[49] *Econ. Geol.*, Vol. 19, pp. 146-156.
[50] *Mem.* Geol. Surv. India, Vol. 44, pt. 2, 1923.
[51] *Mem.* Geol. Surv. Canada, No. 136, 1924.
[52] *Mining Journal-Press*, Vol. 117, pp. 319-324.
[53] *Min. & Met.*, Vol. 5, pp. 423-427.
[54] Iowa Geol. Surv., *Ann. Rep.*, Vol. 28, for 1917-18.
[55] *Bull.* Ky. Geol. Surv., 1924.
[56] *Econ. Geol.*, Vol. 19, pp. 412-433.
[57] *Mining Journal-Press*, Vol. 118, pp. 419-421.
[58] *Rock Products*, Vol. 27, pp. 56-59.
[59] *Idem.*, Vol. 27, pp. 148, 149.
[60] Tenn. Div. Geol. *Bull.* 28, 1924.
[61] Victoria Dept. Mines. *Bull.* 46, 1924. A. M. Howitt.
[62] R. W. Smith, *Trans.* A.I.M.E. No. 1373-M, 1924.
[63] *Mining Journal-Press*, Vol. 118, pp. 491-495.

A Mine Dump at Virginia, Minnesota



Mining Practice

Advances in Mining Methods—Scraper Loaders—Long Drill Hole Prospecting—Ventilation

By George J. Young
Associate Editor, *Mining Journal-Press*

George J. Young

MINING continued to be in the doldrums during 1924. The lead miners were favored with good prices, but copper, gold, and silver miners felt the pinch of low prices. The need for closer study of detailed operations with a view to simplification and greater economy is just as pressing as it was, but, more than this, there is a need for whole-souled cooperation on the part of the miners and underground men with their foremen and superintendents. If low prices are to continue, then it is to the interest of all workers in the industry to do their share in keeping it going.

The year 1924 was noteworthy in the number of coal-mine explosions, which were not confined to any one locality but were more or less widespread. Renewed attention is being given to dusting as a means of prevention. George S. Rice[1], of the Bureau of Mines, has contributed a bulletin on practice in stone dusting in British and French coal mines. A number of articles on the subject also appeared in *Coal Age*. The need for better engineering, closer supervision and more detailed inspection is indicated.

Increased Interest in Electrical Prospecting—Devices Still Experimental

Sampling and Prospecting—Numerous papers on sampling practice appeared during the year. Louis E. Reber, Jr.[2], brought out a standardization of methods of observing and recording data in copper mines; J. Kruttschmitt, Jr., and Guy N. Bjorge worked out similar plans for mines other than copper. J. E. Harding[3] discussed the interpretation of results of churn-drill sampling and the mapping of cross-sections of orebodies. Basil Prescott[4] points out the necessity for a thorough knowledge of the habit of orebodies before a sampling rationale can be worked out. C. H. White[5] discussed prospecting for disseminated copper deposits by a study of leached croppings and gave several examples of the details of the method which are based upon close observation of surface rocks.

P. R. Bradley[6] discussed the sampling of gold mines wherein the gold is erratically distributed, as in the Alaska Juneau mine. In that mine systematic channel sampling has been abandoned as an unnecessary expense and the value of ground not known through actual mining is gained by grab samples taken from the muck during the progress of development work. Assay results are interpreted by experience and knowledge of the ground.

Mechanical and electrical aids to prospecting are discussed by Alfred Gradenwitz[7]. He advocates the concurrent use of several methods and describes gravity determinations by torsional balance and by the Eötvös device; the determination of magnetic forces, and the determination of the electrical conductivity of rocks. Hans Lundberg[8] describes the results of practical experience in electrical prospecting.

The Elbof method of electrical prospecting is mentioned in *Mining Journal-Press* of Oct. 11, 1924, p. 596. In this method a ground current is established and its characteristics at different points upon the surface are determined by magnetic observations.

A description of the Chilson prospecting device was given by Wilbur C. Riley in *Mining Journal-Press*, Nov. 8, 1924, p. 733. The device makes use of an electrical current of audio frequencies between 40,000 and 20,000. Contact of the transmitter is made with the sulphides in place, and a portable receiver enables the signals to be received at any desired point. This receiver is so arranged as to indicate the direction of the radio wave in space, thus giving an indication of the apparant strike and dip of the suspected orebody. The account leaves much to be desired and merely indicates another ramification of experimental electrical prospecting.

Several papers on bore-hole surveying appeared. Sven Lundberg[9] describes in detail the Kiruna method, the basis of which is the determination of the form of the ellipse that results from the intersection of a horizontal plane with a cylindrical surface for various angles of inclination of the cylindrical surface parallel with the axis of the hole. An ingenious arrangement has been worked out for the electrolytic deposition of a copper film on a polished and gilded copper cylinder. As in other methods of bore-hole surveying, a series of observations are necessary at varying depths in the bore hole. G. A. Watermeyer[10] discusses several methods of bore-hole surveying and gives an interesting test of the accuracy of the Gallagher instrument (a compass in gimbals which are loosened at a predetermined time interval and tightened in position after an interval), which showed for a 1,950-ft. hole a deviation of 35 ft. horizontally (6.6 deg. error in compass direction) and 3.87 in 1,900 as an error in level.

[1]Bull. 225, U. S. Bureau of Mines.
[2]*Ming. Cong. Jour.*, Vol. 10, p. 343, 348, 349.
[3]*Mining Journal-Press*, Vol. 117, p. 523, 767.
[4]*Trans*, A.I.M.E., Feb., 1924.
[5]*Mining Journal-Press*, Vol. 117, p. 483.
[6]*Trans.*, A.I.M.E., Feb. 1, 1924.
[7]*Mining Journal-Press*, Vol. 118, p. 54.
[8]Sveriges Geologiska Undersokning; Ser. C, N:o 319.
[9]*Mining Journal-Press*, Vol. 117, p. 690.
[10]*Jour.* Chem. Met. & Min. Soc. of S.A., Dec., 1923, p. 145.

Mining Methods—A number of applications of well-known mining methods were described. Stephen Birch[11] discussed all too briefly a method of shrinkage stoping applied at the Beatson mine in which the orebody is divided into stopes extending across the full width of the orebody and separated by 30-ft. pillars. The stopes are 70 ft. wide. Raises are at intervals of about 60 ft., and the ore is broken by drilling from the raises instead of from the pile of broken ore. The general weakness of the ore mass is given as the reason for this modification of shrinkage stoping. Tons broken per man per shift in stopes is 74.4. In another paper[12] the same writer describes the application of shrinkage stoping in the Bonanza mine. Here the rich ore seam is first mined by shrinkage and the broken ore removed. The mill ore is then broken, filling the voids left by the high-grade stopes. Pillars are left in the floor of this stope and are eventually recovered. The old stopes stand empty, with practically no caving. Filling is, however, practiced. Tonnage broken per man per shift, including miners, bulldozers and muckers, is 11.15.

Two interesting papers on narrow vein mining are given by C. N. Bell[13] and S. J. Kidder. The veins are steep in both instances, and in the paper on the Telluride district filled stopes and shrinkage stopes are described. The large proportion of accompanying waste resulted in the development of underground sorting stations, which reduced the cost of ore sorting materially. In waste-filled stopes the loss of ore is given as 10 to 25 per cent. In open-stulled stopes dilution of the ore up to 25 per cent was experienced. Both of these results indicate one of the important problems to be solved in narrow-vein mining. Production is around eight tons per man per shift in the stopes. In the Mogollon district the stopes range from 8 to 15 ft. and up to a maximum width of 24 ft. The dip is 70 deg. Shrinkage stoping has been found to be the most suitable method. Ore broken per drill shift is given as 10.86 tons.

Mining methods at Gold Hill, Nev.,[14] afford an excellent example of the application of the branch-raise method to the winning of old stope fills and ore remnants in a precious-metal mine. Handling of clayey ore in long ore passes is sometimes an extreme difficulty, which was overcome in this instance by lowering the ore from the mining to the haulage level in skips.

Cutting-in and bench mining, a modification of underhand stoping, and the use of underground glory holes was briefly described by A. H. Hubbell[15] and at considerable length by H. A. Coy and James A. Noble.[16] These methods are applied in mining zinc ore at Mascot, Tenn. Both avoid the use of timber, and their use is made possible by good roof conditions. Room-and-pillar mining of salt at Retsof, N. Y., and methods of underground loading and transportation of salt are described by A. B. Parsons[17].

Iron-ore mining in the Birmingham district and roof support in the red ore mines of the same district are discussed in separate papers by W. R. Crane[18]. The methods are simple and the mining conditions good. Crane calls attention to the increasing use of scrapers in that district and their influence in modifying mining methods. For example, wider stopes are run and headings (wide drifts) are run 150 to 200 ft. apart instead of 55 to 65 ft. Support of stopes is by pillars supplemented by props. Both papers give considerable detail not published hitherto.

In open-pit mining T. A. Rickard described the method of steam-shovel mining at Chino[19]. This involves no unusual features. At the Utah Copper property in Bingham Canyon an important experiment terminated early in 1924. Two shovels were equipped with motors, one for direct and the other for alternating current. As a result of comparative tests, the decision was reached to equip all of the open-pit shovels with alternating-current motors and accessories. Previously the shovels were equipped with caterpillar tractors, which eliminated pit crews. The use of electrical power will result in certain additional economies. It is of interest to note that at Chuquicamata, electrically operated shovels have been in use for a considerable period. These are operated by alternating current. New shovels under order are to be operated by direct current. This divergence of opinion in two large operating organizations really points to the excellence of present-day electrical equipment. The use of caterpillar tractors and electrically operated shovels marks two important advances in large-scale bench mining. The small revolving type of shovel, electrically operated and equipped with caterpillars, is a standard for miscellaneous small quarry operations. For places where electrical power is not available, the Diesel engine-powered shovel answers for small operations.

Open-pit mining practice at the Utah Copper mine in Bingham Canyon I described in detail in the *Mining Journal-Press* of Oct. 25, 1924. Bench blasting by means of long toe holes and intermediate holes in the bench and top holes upon the bench back from the edge, all drilled by reciprocating machine drills, has been systematically developed. Conditions are such that under this method very low costs are obtained. As far as I am aware, no other organization is following the same procedure, but most other companies operating open pits make use of churn-drill holes. Some resort to tunnel blasting. A comparison of the three methods under similar conditions would be of great interest. A novel combination of underground methods with surface glory holes has been applied by R. A. Kinzie to quarrying limestone at Davenport, Calif. The arrangement, described in *Mining Journal-Press*, Nov. 8, 1924, p. 752, is of importance and its application has reduced quarrying costs in the specific instance.

The factors affecting bank slopes in steam-shovel operations are discussed by L. S. Cates[20] in a preliminary paper. This subject is of importance, as upon the determination of a safe angle of slope in open pits depends the amount of stripping necessary to uncover the ore. The Institute's Committee on Ground Movement and Subsidence is at present gathering data and will present a final report in 1925.

Although coal-mining practice is not covered in this review, an important paper that describes the application of conveyors in mining coal by a unique system,

[11] "Geology and Mining Methods of Beatson Mine." *Trans.* A.I.M.E., Feb., 1924.
[12] "Geology and Mining Method of Kennecott Mines." *Trans.* A.I.M.E., Feb., 1924.
[13] "Mining Methods of the Telluride District," by C. N. Bell. "Mining Methods in Mogollon District," by S. J. Kidder.
[14] *Mining Journal-Press*, Vol. 117, p. 916.
[15] *Mining Journal-Press*, Vol. 118, p. 409.
[16] *Trans.*, A.I.M.E., Oct., 1924.
[17] *Mining Journal-Press*, Vol. 117, p. 997.
[18] *Trans.*, A.I.M.E., Oct., 1924.
[19] *Mining Journal-Press*, Vol. 116, p. 1113.
[20] *Trans.*, A.I.M.E., Feb., 1925.

the V method,[21] is worth the attention of metal miners. An installation of portable conveyors is used for removing the coal from the faces and loading into the cars on the main haulage entries.

J. A. Macvicar, in the March and April, 1924, numbers of the *Mining Magazine*, discusses at length the application of the diamond drill in oil-well drilling. This phase of diamond drilling is in the experimental stage, and it is yet to be demonstrated whether it will be of importance in the petroleum fields or not.

Shaft Sinking—The application of the Francois cementation process to a difficult piece of shaft sinking on the Far Western Rand is described by G. A. Voskule.[22] A bed of wad was encountered at 130 ft. in depth; ordinary methods of sinking were unsuccessful, and the shaft was abandoned. Near by a new shaft (19 by 9 ft. in section inside timbers) was sunk. At a depth of 108 ft. a bed of boulder clay was cemented through six drill holes in stages of three feet from the top down. The wad was cemented in stages also. The shaft was sunk successfully past the soft bed. Charles H. Foreman discusses methods of cementing water-bearing fissures in the Star crosscut, giving details of the cement pump and the results of the work.[23] W. V. De Camp used reinforced-concrete rings in shaft work in place of a continuous lining of concrete. The arrangement applied to a hard rock shaft at the United Verde mine resulted in saving one-half the amount of concrete that would have been required by continuous lining.

Mine Drainage—Little has appeared that is novel in mine drainage. E. F. Irving[24] gives in detail the design of the Junction shaft pumping installation, where water is removed by electrically operated pumps in a single lift of 2,200 ft. For continuous heavy service from considerable depths, the horizontal duplex plunger pump appears to find favor. The Tonopah Extension mine installed pumps of a similar type during 1924. Concreting channels of surface streams to cut off water from mine workings is only occasionally resorted to as described in the instance of the Mascot mine by H. A. Coy and James A. Noble.[25] The practice deserves greater recognition by engineers as a possible direction in which further economy in operation can be effected.

Mine Transportation—L. L. Quigley[26] describes the design of a side-dumping mine car which has the merit of compactness with large capacity. A compressed air cylinder is used for dumping the cars. Quigley points out the economy to be derived by larger car units both in reducing the car equipment per level and in increasing the labor output. Norman Carmichael and John Kiddie[27] discuss in considerable detail the transportation methods and equipment employed in the Clifton Morenci district. M. L. O'Neale[28] summarizes the various methods of transporting coal down hillsides, and his treatment discusses chutes, gravity planes, belt conveyors, pan, scraper, and rope-and-button conveyors. The construction of a long rope-and-button conveyor is given by W. J. Denman.[29]

Loading Machines—Loading machines are important to the coal miner as instanced by the number of papers on the subject appearing in *Coal Age*. The metal miner has not found the heavier commercial machines entirely suitable and has continued to develop the scraper loader. I. W. Farrand describes a scraper loader[30] used at Cerro de Pasco that employs a special truck equipped with compressed air cylinders for raising the loader into position. The loader is held in position by jacks. A double-drum air-operated hoist and scraper are used for moving the rock. A self-contained scraper loader of similar type is described by G. C. Newton.[31] The Wagner scraper loader is similar in principle.[32] All three of the machines make use of an inclined apron. Without much doubt this form of scraper loader will be used to a considerable extent in metal mines. In addition to well-known types, the following loaders have been introduced: the Joy loader, Dilig tractor loader, Holmstead loader, Wilson chain loader, O'Toole, Conweigh loader, Coloder, and the Goodman scraper loader. Most of these have been discussed in relation to coal mining, or advertised.

The use of the scraper and hoist in mining continues to advance. A. S. Winther has made use of the scraper in narrow, flat, overhand stopes by planking the fill and scraping the broken ore to the chute. Waste is drawn in and distributed by the scraper also. The arrangement avoids the use of closely spaced ore chutes and the tramming of waste to the fill. It reduces the proportion of open stope to a minimum.[33]

Ventilation—The paper on the ventilation problems at Champion Reef mine, Mysore, South India, by C. F. Heathcote[34] brought out a considerable discussion of the ventilation of deep, hot mines by members of the Institution of Mining and Metallurgy, of London. The Champion Reef mine is worked to a depth of 6,194 ft., the rock temperature being 119 deg. at this depth. Under natural ventilation the maximum flow of air was 92,000 cu.ft. In-coming air temperature ranges from 65 to 95 deg., and high humidity prevails, as the mine is in the tropics. Mechanical ventilation was installed to better working conditions, two large fans being placed underground on No. 40 and No. 41 levels. Sufficient improvement was obtained, but short-circuiting reduced the effectiveness of the fans.

Thomas G. Hauton[35] gave a detailed account of the development and completion of a system of ventilation for the mines of the Zinc Corporation which is of interest to large mine operators. W. J. McConnell and C. P. Yaglaglon[36] discuss the limitations of the kata-thermometer and endeavor to work out the relation between the indications of the instrument and human comfort. Robert S. Lewis[37] describes the results of observations with the kata-thermometer in certain Tonopah mines. E. H. A. Joseph and R. A. H. F. Flugge-de Smidt[38] discuss the dust problem and its solution with respect to development ends. S.-de Smidt and H. Pirow give the results of a series of experiments with Venturi blowers in the March, 1924, number of the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa.

Substantial progress in applying principles of mine

[21] "Coal Mining by the V System," by Glenn B. Southward, *Trans.*, A.I.M.E., Feb., 1924.
[22] *Jour.* Chem. Met. & Min. Soc. of S.A., Vol. 24, p. 186.
[23] *Min. & Met.*, Vol. 5, p. 417.
[24] *Mining Journal-Press*, Vol. 117, p. 1041.
[25] *Trans.*, A.I.M.E., Oct., 1924.
[26] *Mining Journal-Press*, Vol. 118, p. 57.
[27] *Trans.*, A.I.M.E., Feb., 1924.
[28] *Coal Age*, Vol. 25, p. 715.
[29] *Coal Age*, Vol. 25, p. 235.
[30] *Mining Journal-Press*, Vol. 117, p. 531.
[31] *Mining Journal-Press*, Vol. 117, p. 531.
[32] *Compressed Air Magazine*, Vol. 29, p. 835.
[33] *Mining Journal-Press*, Vol. 118, p. 618.
[34] *Trans.* Inst. M. & M., Dec., 1923.
[35] *Proceedings* Aust. I. M. & M.; N. S. No. 49, 1923.
[36] U. S. Bureau of Mines, Serial No. 2565, Report of Investigations.
[37] *Mining Journal-Press*, Vol. 117, p. 363.
[38] *Jour.* Chem., Met. & Min. Soc. of S.A., Jan., 1924; p. 167.

ventilation to metal mines is indicated during 1924 as well as the increase in the knowledge of all of the factors necessary to bring about atmospheric conditions that will make working places more comfortable and bring about increased efficiency.

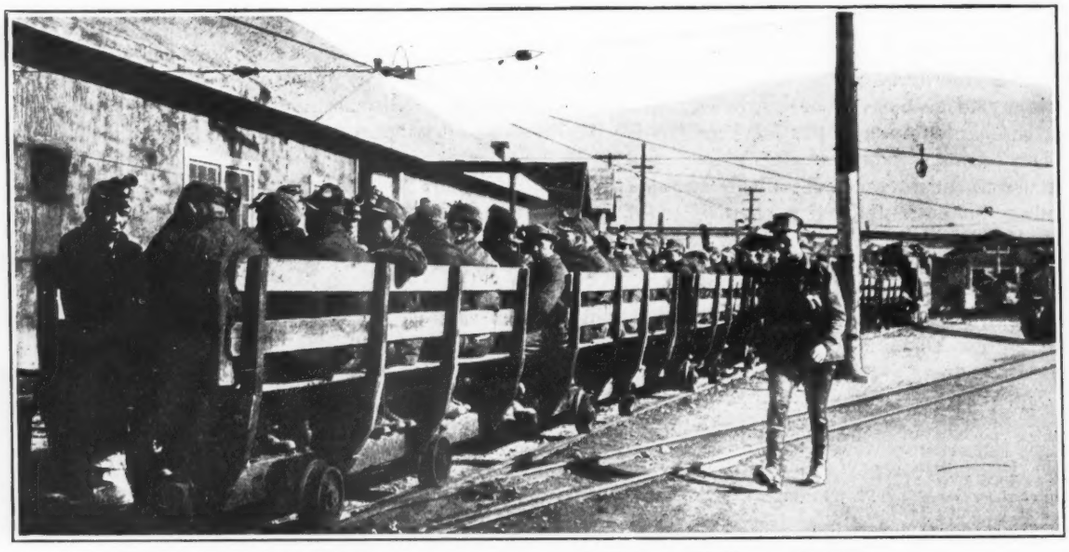
Rock Drilling and Drill Steel—E. R. Borcherdt and H. D. Sultzer are the authors of a series of papers on the care and use of rock drills which were published in the *Anode*. These are well worth careful study by operators. Butte practice is the basis of the articles. Frank Richards[39] gives good advice on the care and operation of air compressors. Drill-sharpening practice at the United Verde mine is described in an article which I wrote for *Mining Journal-Press*.[40] At this mine the drill-sharpening practice has been standardized and placed under close supervision. The effort is successfully made to send only steel true to gage and properly heat treated into the mine. An automatic tempering machine has been experimentally used successfully for some time. In mines where hard drilling conditions are encountered an important economy can be effected by bringing the drill-sharpening practice up to a high standard. Drill footages are increased and time is saved. F. B. Foley, C. Y. Clayton, and M. L. Frey[41] direct attention to the failure of hollow drill steel due to physical defects in the steel. They found traverse cracks along the water hole.

Without doubt one of the most important recent adaptations of the rock drill is for the drilling of long holes for prospecting purposes. The equipment for this purpose developed by the Denver Rock Drill Manufacturing Co. and described by H. R. Drullard[42] enables long drill holes up to 100 ft. and more to be extended from drifts and crosscuts at a relatively low cost and without increasing the dimensions of the drift at the point of drilling. This is accomplished by sectional drill rods which are joined by steel couplings. A special water swivel is used. The method is apparently restricted to the softer rocks—limestones, schists, and altered rocks—but some operators have used it in hard rock for relatively short holes. The drill cuttings are caught, and by their examination the mineral content is determined. Diamond drilling has not been displaced, but a field hitherto too unprovided with suitable appliances is now being served.

Use of Mine Timbers—A useful discussion of the properties of mine timber is given by R. P. A. Johnson,[43] who states that the density or dry weight of clear wood is the best criterion of its strength. He points out that local timber will often have a greater strength than the low-grade timber of a tree species normally of greater strength. He advocates sorting mine timbers with a view to deriving greater advantage from the stronger timbers. Two papers in *Coal Age*, one dealing with the quantity of timber used in soft coal mines[44] and the other on hydraulic storage,[45] may be useful in a general way. A new wood impregnant has been placed on the American market by German interests under the name of Wolman salts. It is a derivative of creosote and is said to act as a fire retardant and preservative. It is used under pressure and less effectively by ordinary submersion. The compound is soluble in water. John G. Kreer describes some of its properties in the Nov. 1, 1924, issue of *Mining Journal-Press* (p. 714).

Explosives—Two papers on the nature and use of commercial explosives in mining that are general and useful to operators appeared during 1924.[46] In both papers comment is made that the latest types of non-freezing powders have made it possible to conduct blasting operations at zero temperature with no more difficulty as far as the condition of the explosive is concerned than was experienced at 50 deg. The use of low-density explosives enables charges to be distributed over a greater proportion of the drill hole without waste in the quantity of explosive. High-density explosives are, however, more suitable for tough rocks.

[39] *Compressed Air Magazine*, Vol. 29, p. 819.
[40] *Mining Journal-Press*, Vol. 117, p. 570.
[41] *Trans.*, A.I.M.E., Feb., 1924.
[42] *Mining Journal-Press*, Vol. 117, p. 384.
[43] *Mining Journal-Press*, Vol. 117, p. 240.
[44] *Coal Age*, Vol. 25, p. 563.
[45] *Coal Age*, Vol. 25, p. 355.
[46] *Mining Journal-Press*, Vol. 117, p. 197; *Min. & Met.*, Vol. 5, p. 428.



Going on Shift at the Bunker Hill Mine, Kellogg, Idaho

Milling and Flotation

Simplification of Mill Flow Sheets—All-Flotation Becomes of Greater Importance

By Charles E. Locke
Assistant Professor of Mining and Ore Dressing, Massachusetts Institute of Technology, Cambridge, Massachusetts

Charles E. Locke

THE record of 1924 in concentration may be set down as showing nothing revolutionary, but, nevertheless, it marks a continuation of the progress of recent years toward simplicity in mill flow sheets; more, and better, flotation, and higher extractions as well as greater operating profits. The improvement in industrial conditions manifested toward the end of 1924 leads to the hope for greater progress in 1925. Improvements in crushing machinery have been along the line of larger, stronger, and more rugged units. As will be seen later, the machines mostly prescribed in modern flow sheets are jaw breakers, gyratory breakers, Symons disk crushers, rolls, rod mills, and ball mills. Chile mills have practically disappeared with the remodeling of the Utah Copper Co.'s mills. Stamps continue to be widely used in gold mills, but it is significant that in the two new mills in South Africa, the New States Areas and the West Springs, the example of the Hollinger mill, in Canada, in replacing stamps by revolving mills has been followed.

Increased Use of Rod and Ball Mills

Increased use of rod mills and ball mills has come with the increased application of flotation. Perhaps the most important development in these mills has been in the use of rubber lining where the feed is not too coarse, limited to not over ¼ in. Their success at the Nipissing mill, in Canada, has led the Phelps Dodge Corporation to try them out in its Bisbee mill, and the report comes from South Africa that encouraging results are being obtained in tube mills lined with rubber 1½ in. in thickness. The Nipissing lining was only ⅝ in. in thickness. For crushing media, the Nacozari mill has been experimenting with 3-in. chilled cast-iron cubes in place of rods or balls. The results so far are reported to be favorable, but the tests have not been completed.

Balanced mills, for rods or balls, have come on the market. These replace the single compartment of an ordinary mill by several compartments around the mill axis on much the same principle as the multiple cylinder drier. Such mills would seem to be of doubtful advantage. Another innovation is the Fairchild double-discharge mill, the rights of which have been acquired by the Vulcan Iron Works, of Wilkes-Barre, Pa. This changes an ordinary mill into two separate compartments by a vertical partition at the middle.

Vibrating screens continue to find favor. A new heavy-duty Hum-mer screen, known as Type 39, is on the market and possesses twice the power of the Hum-mer standard vibrator. Another vibrating screen is the Leahy No-Blind screen made by the Deister Concentrator Co. This is preferred over all other screens in the southeast Missouri lead mills. Several other manufacturers have put out various forms of vibrating screens.

New Hydraulic Classifier Introduced

About the only development in hydraulic classifiers is the Coeur d'Alene classifier with automatic density control. It is the result of work by A. W. Fahrenwald, of the U. S. Bureau of Mines, and made its first success in the Bunker Hill & Sullivan mill in Idaho, where it demonstrated its ability to do high-grade work. Other installations have been made in that district, in Alaska, and in Missouri. Dorr mechanical classifying and thickening apparatus remains a standard in fine grinding and flotation work. The tendency is toward increased use of Dorr bowl-classifiers in place of the plain rake type.

Simple flotation of sulphides has reached the stage where there is usually little difficulty in obtaining satisfactory results by the use of standard apparatus and reagents. Recent experience has shown that, where high-grade concentrate is desired, it is only necessary to repeat the cleaning operation two or three times, the extreme cases being at present the Nacozari and Chino mills, which use rougher, cleaner, recleaner, and re-recleaner cells.

However, in selective flotation of one sulphide from another or in the flotation of oxidized ores, the art has not progressed as far, and, although material advance was made during 1924, much still remains to be done. Separation of copper sulphide, especially chalcopyrite, from iron sulphide (pyrite and pyrrhotite) can be well done; likewise nickel and copper sulphides from pyrrhotite. Various mills are separating zinc, iron, and lead sulphides from one another, but the separation is by no means complete. Probably the best results are those obtained on the zinc-lead ores at the Kimberly mill, in British Columbia. One promising solution of the lead-zinc problem is the installation of a 1,300-ton custom flotation plant at the Tooele smelter, in Utah, to handle this class of ore. By thus specializing, skilled operators should be developed who would outrank in ability the operators in many individual plants, and, furthermore, small mines will be relieved of the expense of installing and operating selective flotation plants of their own.

Respecting oxidized ores, there are indications that the next important developments in flotation will affect the treatment of such ores. Already several companies

are doing very good work on lead and on copper ores, but are not saying much about it. It is understood that Minerals Separation investigations on Katanga oxidized copper ores have been so successful that an experimental mill is now being erected in Africa. Sodium sulphide and calcium polysulphide seem to be preferable to hydrogen sulphide for filming oxidized ores.

Much of recent progress in flotation is due to organic reagents. First was X-Y (alphanaphthylamine and xylidine); then T-T (thiocarbanalid and orthotoluidine); more recently the xanthate of either potassium or sodium; and lastly the Q. E. D. reagent, the composition of which has not been made public, and which is effective in very small amounts. The xanthates are Minerals Separation reagents; the others are the "alphabet" reagents of the Metals Recovery Co. With these reagents has come greater use of alkaline pulp and alkaline salts such as sodium cyanide, sodium carbonate, sodium silicate, and lime. Disodium hydrogen phosphate is used for separating galena from blende in the Coeur d'Alene district.

Flotation Reagents Are Investigated

As more study is given to the action of flotation reagents, the questions arise whether the entire constituents of common reagents are effective, whether the effect does not arise from small ingredients in these reagents, and whether the same flotation effect would be obtained by isolating these ingredients. Along this line H. E. Frederick[1] has demonstrated that flotation results only from the acid or basic portions of the reagents, which portions act either in solution or in colloidal condition. The active portions carry static electrical charges which attract or repel a mineral according to the sign of the charge carried by the mineral. T. M. Bains, Jr.,[2] has also carried on interesting work on the static electrical charges produced in flotation.

Renewed flotation litigation was impending on the expiration of the Anaconda contract, simultaneously with the lapse of the Minerals Separation basic frothing patent, but this was averted by a new contract which, it is understood, cuts the royalty in half. The Jackling properties automatically receive the same rates as Anaconda. The new contract is to run until other important Minerals Separation patents expire. The long-delayed decision in the Magma case has not yet been handed down, and little progress has been made in the Wolf suits.

Special processes involving the use of pneumatic tables for treating coal seem to be expanding. Likewise the Chance sand flotation, or intermediate density process, is meeting with wonderful success on anthracite coal and is to be extended into the bituminous field. In due time its principle should be applied to ores, where there is apparently an excellent field for it.

Experimentation in Dielectric Separation

Experimental progress in dielectric concentration has reached the stage where an apparatus to treat one ton per day is in operation. This process depends upon the dielectric constant or specific inductive capacity of particles and differs from the Huff electrostatic process in that it depends on the behavior of *uncharged* particles in an electrostatic field produced by an alternating current. The separating medium must have a dielectric constant intermediate between the dielectric constants of the two minerals to be separated, since in such a medium the particle having a dielectric constant greater than that of the medium is attracted while the particle of lower dielectric constant than the medium is repelled. Furthermore, the medium should be low in conductivity to avoid the necessity of using a strong current to maintain the electrostatic field. These conditions are best fulfilled by certain oil mixtures whose dielectric constants may be readily varied by changing the proportions of the ingredients. There seems to be no limit to the fineness of the material that can be separated, but the indications so far are that the process will not be a cheap one unless reagents can be found of lower cost than those employed to date.

Increased Use of Rubber for Linings

There is not much that is new in accessory apparatus. For economical handling of pulps containing solids up to ¾ in. in size the Wilfley centrifugal sand pump seems to be most popular everywhere. The ability of rubber to resist abrasion is leading to an increased use, not only for tube-mill linings but also as a covering on flotation impellers, chutes, launders, centrifugal pump motors, and shells. It also makes a very satisfactory bearing for parts revolving under water. Considerable attention is now given to the control of dust in the dry parts of mills. This not only assures a healthier atmosphere and less wear of machinery, but it also yields a surprising recovery of metal from the dust which formerly went to waste.

A number of new and remodeled mills started during 1924, and the following brief outlines of many of these are given to illustrate the crushing practice of today and also to show the marked tendency toward flotation and greater simplicity in flow sheets:

Important Changes in Old Plants

The remodeling of the Magna and Utah mills of the Utah Copper Co. has increased the flotation and reduced the table work. These mills now have a combined capacity of 40,000 tons per day, and in the third quarter of 1924 obtained an extraction of 87.24 per cent of the copper from a feed assaying only 1.06 per cent copper. The mills, before remodeling, obtained an extraction of only 65 per cent. Somewhat similar changes have been made by the Ray Consolidated company and a corresponding improvement has been shown in the results.

The new 5,000-ton copper concentrating plant of the New Cornelia company at Ajo, Ariz.,[3] uses a 54-in. gyratory crushing to 6 in.; No. 8 gyratories crushing to 3 in.; 48-in. Symons horizontal disk crushers crushing to 1¼ in.; 78 by 25-in. rolls crushing to ⅝ in.; primary Marcy rod mills, 6 by 12 ft., reducing to about 10 mesh; similar secondary mills grinding to about 48 mesh, and pneumatic flotation consisting of roughing treatment followed by a single cleaning of the rougher concentrate. Tables were included in the original plans of this mill, but it has not been found necessary to install them.

The new Copper Queen mill[4] at Bisbee has an 84 by 66-in. jaw crusher reducing to 8 in.; No. 9 Gates crusher to 4 in.; 48-in. Symons horizontal disk crusher to 1¼ in., and 6 by 12-ft. Marcy rod mills to 14 mesh. The concentrates are removed by tables from the 14-mesh pulp

[1] *Mining Journal-Press*, Vol. 118, p. 11.
[2] *Mining Journal-Press*, Vol. 117, p. 885.
[3] H. K. Burch; *Mining Journal-Press*, Vol. 118, p. 808.
[4] E. Wittenau; *Mining Journal-Press*, Vol. 117, p. 836.

and the table tailings reground in rod mills to 48 mesh for pneumatic flotation, which is in two stages. The first-grade concentrate from the rougher and all the concentrate from the cleaner go to a finishing table to remove iron. The second-grade concentrate from the rougher goes to the cleaner. The tailing from the rougher goes to tables to recover additional mineral which escapes flotation while the tailing from the cleaner goes back to the rougher. The ore assays 2.09 per cent copper; concentrate 8.60 per cent, and tailing 0.22 per cent, indicating an extraction of 91.8 per cent. and a concentrating ratio of 4.5 into 1.

The new 5,000-ton copper concentrating mill of the Phelps Dodge Corporation at Morenci reduces the mine ore to 2.5 in. by gyratory crusher; to 0.5 in. by 72 by 24-in. rolls, and to 6 mesh by 54 by 24-in. rolls. Tables remove concentrate at 6 mesh and send the tailing to 8-ft. by 48-in. Hardinge ball mills, which grind to 48 mesh for primary flotation. This yields a first-grade finished concentrate, a second-grade concentrate that goes to the cleaner flotation, and the tailing is reground in similar ball mills to 65 mesh for secondary flotation. This, in turn, gives a concentrate that goes to the cleaner and a tailing that goes to waste. The cleaner makes a finished concentrate and a tailing which goes back to the primary flotation. Special stress is laid on the guarding effect of the three stages of concentration at 6, 48, and 65 mesh, no one of which involves the use of finishing tables. The feed assays 2 per cent copper, the extraction is 85 per cent and the concentration ratio is 10 into 1.

Miami and Nacozari Adopt All-Flotation

The Miami mill has also adopted all-flotation and has a rather unique scheme of two units, one for coarse-classifier sands and one for fine-classifier overflow. Each unit has a roughing and cleaning cell and makes finished concentrate, but the tailing of the coarse unit rougher is returned to the ball mill and held in closed circuit with the ball mill, classifier, and coarse unit until it escapes either as coarse flotation concentrate or as classifier overflow going to the fine unit. Tailings from coarse and fine cleaners are returned to the coarse rougher. The final products are therefore concentrates from the coarse and fine cleaners and tailing from the fine rougher. The end of the Miami higher-grade ore is in sight, and the company plans to enlarge its plant to treat 10,000 tons daily, on which scale it is felt that a profit will be obtained on low-grade ore carrying about 1 per cent copper.

By gradual steps the Nacozari copper mill has diminished its gravity concentration, year after year, until it is now an all-flotation plant except for the use of a finishing table to remove coarse mineral from a flotation concentrate.[4] The five crushing steps are: No. 8 McCully gyratory to 2¾ in.; No. 4F Telsmith crusher to 1½ in.; 48-in. Symons disk crushers to ¾ in.; 6 by 12-ft. Marcy rod mills to 14 mesh, and 6 by 12-ft. secondary Marcy rod mills to 48 mesh. The flotation consists of one rougher treatment followed by three successive cleaning flotation steps for the rougher concentrate. As the ore contains pyrite along with the chalcopyrite, the present process removes 90 per cent of the pyrite as waste, against 25 per cent formerly removed by the old combined gravity and flotation process. Concentrate now assays 28 per cent copper, 29 per cent iron, and 8 per cent insoluble as against 12 per cent copper, 32.5 per cent iron, and 18.5 per cent insoluble formerly. Extractions and tailing assays are essentially the same by both processes. On a feed containing 2.5 per cent copper, the tailing assay is about 0.2 per cent copper, showing an extraction by the all-flotation process of 92 per cent and a concentration ratio of 12 into 1. With the same feed and extraction the old process gave a concentrating ratio of only 5 into 1. All of this means a large increase in the net profit.

Another new small mill is the California Rand 400-ton mill treating a silver sulphide ore.[5] It uses a 10 by 16-in. Blake breaker to 1½ in.; 9 by 15-in. Dodge breaker to 1 in.; 5 by 4-ft. ball mill to 3 mesh, 5 by 10-ft. tube mill to 80 mesh and one Minerals Separation flotation machine. The extractions are 97.45 per cent of the silver and 84.5 per cent of the gold. An example of small mill practice is the Walker mill, in California, described in the *Mining Journal-Press* of May 3, 1924, p. 725. The ore contains chalcopyrite with accessory gold and silver, and is treated by flotation.

On lead ores in the Flat River district of Missouri the tendency toward finer crushing is apparent. Several mills have discarded jigging entirely and have only tables and flotation machines. Similarly, from the Coeur d'Alene lead district the report comes that the Morning mill, in its experimental work, is obtaining a concentrate assaying 55 per cent lead by fine grinding and flotation, compared to a 44 per cent concentrate obtained by the usual process of coarser crushing, jigging, tabling, and flotation.

The Utah Apex mill, which formerly used jigs, tables, and flotation in the treatment of a silver-lead ore, now crushes to flotation size in three stages—jaw breaker, 40 by 15-in. rolls, and No. 64½ Marcy ball mills. In the Callow cell flotation the primary roughers make a finished concentrate and send the tailing to secondary roughers which make concentrate for the cleaners and tailing for the tables. The cleaners make a finished concentrate and return their tailing to the primary roughers. The tables make a finished concentrate, a middling which is returned to the tables and a tailing which goes to waste. On a feed assaying 7.75 per cent lead and 2.37 oz. silver per ton, the extraction is 94.4 per cent of the lead and 90.6 per cent of the silver.

New Process Combining Flotation and Volatilization

A process which may be of far reaching economic importance has been installed by the Chief Consolidated at Tintic, Utah, to handle lead-silver ores carrying both oxides and sulphides. The ores are reduced to 80-mesh size by breaker, rolls, and ball mill. Flotation is first employed to remove most of the sulphides. Tables next take out the remaining sulphides and the compact particles of oxides. Finally, an oxide volatilization and fume precipitation recover the remaining oxides of lead and the precious metals.

As a striking example of modern efficiency and economy in mining and milling the Alaska Juneau report for October showed a metal recovery of 66.18c. per ton and a total operating cost of 48.35c. per ton. After adding all capital and interest charges to the operating expense, the net profit was $10,000 for the month.

[4] W. T. MacDonald: *Mining Journal-Press*, Vol. 118, p. 445.

[5] M. N. Colman: *Mining Journal-Press*, Vol. 118, p. 175.

Hydrometallurgy

Need for Cheap Solvents—Leaching of Lead Ores—Expansion in New Fields

By A. W. Allen
Assistant Editor, *Chemical and Metallurgical Engineering*, San Francisco

A. W. Allen

REFINEMENTS in the physics and chemistry of gravity leaching, and the extension of application of the basic principle, characterize progress in the hydrometallurgy of copper. The treatment is being continued of caved ore, "in place," by the gravity percolation of leach solution at the Ohio Copper mine. Detinned scrap is the precipitant, the product averaging 90 per cent copper. Output is about 1,000,000 lb. per month, at an operating cost slightly under 5¾c. per pound. Only a small proportion of the surface has been wetted, and success to date indicates that a continuance of the method will be possible for a considerable period. A similar procedure is reported from the Oversight, Cananea, and at Kimberly, Nev. Shannon Copper is making an experiment of roasting, "in place," a pyritic ore, preparatory to adopting underground leaching. The heap leaching of surface dumps continues in Arizona and New Mexico.

C. H. Benedict, the "father" of ammonia leaching, has been generous in his contributions to current technology, for details of which the reader is referred to the *Transactions* of the Institute and to *Mining Journal-Press* for 1924. The successful beneficiation of Calumet & Hecla tailing, whereby copper is being produced at a total cost of under 6½c. per pound, is due largely to gravity leaching in large individual units. The company's Tamarack reclamation plant is expected to go into operation in the spring of 1925.

Need for Cheap Solvents

A cheap solvent is necessary for the economical leaching of oxide copper ores, which are usually low grade; acid, with or without ferric sulphate, has given the best results; but in many districts its manufacture is as impracticable as is its importation. W. E. Greenawalt, taking advantage of the fact that both sulphide and oxide ores are usually found in the same district, proposes (U. S. Patent No. 1,483,056, Feb. 5, 1924), as a basic process applicable to a wide variety of ores, (1) the production of a relatively small proportion of high-grade concentrate, which is roasted to make a large percentage of the copper water-soluble; (2) leaching, and electrolyzing the resultant solution, thus producing a large excess of acid; (3) applying the excess acid to the oxidized ore, and (4) using the sulphur dioxide from the roasting furnace to reduce the ferric iron produced. The practicability of this process has been demonstrated by the operation of a pilot plant over a length of time sufficient to indicate the probability of encouraging results when applied on a large scale. The regeneration of acid averages from 2.5 to 3 lb. per pound of copper deposited.

G. D. Van Arsdale's leaching process, for the treatment of Inspiration ore, has passed the pilot-plant stage, and it is reported that technical details will be released in the near future by the president of the company. The ferric sulphate-sulphuric acid process, in which induced oxidation of the solution is a feature, devised by E. S. Leaver (U. S. Patent No. 1,477,965, Dec. 19, 1923), is being developed by the U. S. Bureau of Mines; and a pilot plant will soon go into operation at Tucson, Ariz. In this connection, C. G. Maier, at the Berkeley Experiment Station, has concluded interesting research on the subdivision of air, in connection with the proposed utilization of roaster gas in the solution-regeneration phase of the process. The Union Minière, in the Belgian Congo, continues to operate its pilot plant. Comparatively fine crushing is practiced, followed by pulping in Dorr agitators, with solution displacement in classifiers and thickeners. American sulphur is used for the manufacture of acid.

Tainton's Work Reviewed

Lead and Zinc—The work of U. C. Tainton marks significant progress in the hydrometallurgy of lead. At Kellogg, Idaho, the Bunker Hill & Sullivan company had a pilot leaching unit, with electrolytic recovery of lead and silver, operating during 1924. This is believed to be the pioneer application of continuous cyclic operation of a plant of this type for the recovery of lead directly from ore, the process being available also for the recovery of lead from the residue of acid-leached zinc-bearing material. Old tailings are now being treated, containing about 1.6 per cent lead and 0.75 oz. silver per ton; 100 tons per day is given a rough gravity concentration, which triples the metal content. The concentrate is lightly roasted, without salt, to convert the sulphide into sulphate.

The leaching solution is an acid brine containing a small quantity of free chlorine and calcium chloride, which reacts with the lead sulphate to form soluble lead chloride and insoluble calcium sulphate. Thickeners effect a separation. Silver and copper in the solution are precipitated by agitation with sponge lead derived from subsequent electrolysis. After separation of the precipitate, the lead is recovered in electrolytic cells with rotating cathodes and insoluble anodes, being detached by the scouring action of the electrolyte and carried out by the effluent, collected in a drag classifier, briquetted, and melted. Part of the precipitated solution passes through the anode compartment, where it is impregnated with chlorine, and then returns to the leaching circuit. The chlorine gas goes to an absorption

system to be converted into calcium chloride for re-use.

The results have demonstrated the feasibility of operating an electrolytic plant at a current efficiency of over 90 per cent with leach solution containing only 6 to 10 lb. of metal per ton. The deposition and stripping of the metal cathode is continuous and concurrent. This avoids hand labor and allows the metal from all cells to be aggregated and handled by ordinary means. Silver extraction is from 85 to 95 per cent; that of lead usually exceeds 95 per cent. F. E. Elmore's process for the recovery of lead from Burma concentrate is said to have entered a new phase: Semi-commercial operations have demonstrated the desirability and practicability of the direct manufacture of lead chloride.

The Coolbaugh plant at Durango, Colo., was in intermittent operation throughout 1924. About 9,000 tons of complex zinc concentrates has been treated, the advance in application of the process being evidenced by the fact that 83 per cent of the zinc can now be made water-soluble, with 11 per cent zinc in the calcine.

Early in 1925 the plant will begin the treatment of 1,000 tons per month of middlings from the Sunnyside concentrate at Eureka, Colo.

The Malm dry-chlorine process will soon go into operation at a new plant near Denver, Colo., where zinc chloride will be produced in addition to metal. To many metallurgists this process has favorable features over those that involve a preliminary roast; others, although recognizing the soundness of the fundamental reactions on which it is based, question its practicability. The Tainton "high-acid" process was described in a bulletin of the Institute early in 1924. The Snyder-Christensen process, as adopted recently at Bauer, Utah, was described by A. B. Parsons in the January 10 issue of *Mining Journal-Press*.

Expansion of Hydrometallurgy in New Fields

Iron, Nickel, Cobalt, Vanadium, and Aluminum—The hydrometallurgical recovery of iron from ore is attracting attention. The Canadian Government recently started a Eustis-process pilot plant at Ottawa; it is planned to operate first on concentrates from Britannia, B. C., and from the Eustis mine, in Quebec. The Niagara Electrolytic Iron Co. is building a plant at Niagara to use the French process, but a small Eustis unit will be erected alongside to permit a comparison of results. A. J. Moxham's process (U. S. Patent No. 1,489,362, April 8, 1924) has passed the experimental stage. Success is reported in the treatment of Delaware green sand and the extraction of iron oxide, potash alum, and sulphate of potash.

M. H. Caron's process (U. S. Patent No. 1,487,145, March 18, 1924) offers a solution of the problem of treating low-grade nickel silicate ores, with the additional possibility that a separation between nickel and cobalt may be effected from double-metal ores. The Burma Corporation is producing increasing amounts of nickel speiss, for the treatment of which a plant is under consideration.

The award of the Grasselli medal to Dr. B. D. Saklatwalla deflects attention to progress made in the metallurgy of vanadium. Although most of the ferro-vanadium is produced by the direct smelting of ores and slags, improvements are noted in the wet process, followed by reduction of the oxide by aluminum. The precipitation of calcium vanadate from the mine waters at Mina Ragra, Peru, is an interesting example of hydrometallurgical extraction. The U. S. Bureau of Mines is continuing research on the leaching of clay as a preliminary to the production of aluminum.

New Advances in Cyanidation

Gold and Silver—In cyanidation, the problem of treating carbonaceous material still receives attention. The Ashanti Goldfields company is reverting to former practice—roasting and bulk leaching—after a change to milling in cyanide which proved disastrous. André Dorfman, in an Institution bulletin, discloses pre-oiling practice at the McIntyre plant, at Porcupine. Qualitative tests demonstrated that "the gold and silver removed from the solution by the carbonaceous schist are in the chemical forms of their respective double cyanide salts . . . ," thus confirming conclusions reached elsewhere with other ores. Credit for the pre-oiling idea is apparently due to concurrent research by Dorfman and Albert Silver, of Tonopah. This method has been successful as a palliative in the treatment of tailing at Jackson, Calif., by Hamilton, Beauchamp & Woodworth. Coal tar is used (3 lb. per ton of slime and 1 lb. per ton of sand), permitting an extraction by cyanide of 50 to 60 per cent from material of varying refractoriness, as compared with 30 to 40 per cent when pre-oiling is not practiced.

The use of activated char as a substitute for zinc is proposed by R. H. McKee and P. M. Horton, who are publishing, in *Chemical and Metallurgical Engineering*, perhaps the most scientific contribution to the literature of the subject since the adsorption theory was advanced. Intensive research, which indicates the value of alkaline pre-treatment, prompts the conclusion that the gold and silver in cyanide solutions are adsorbed chiefly as the metals. A load of 2,000 oz. gold per ton of char has been obtained. So logical a method of "precipitation" deserves more than scant attention.

At the new West Springs all-slime plant, in the Far East Rand, a preliminary washing of the ore is a feature of operations, but metallurgical data have not been released. A comparison of results at two other Far East plants, at one of which almost the entire recovery is made in the cyanide plant, is as follows: *Brakpan*—Mill recovery, 55.626 per cent; cyanide recovery, 41.104 per cent; total recovery, 96.73 per cent from 8.6-dwt. ore, leaving 0.3151 dwt. in the residue. *Springs*—Mill recovery, 10.212 per cent; cyanide recovery, 84.161 per cent; total recovery, 94.373 per cent from 9.9-dwt. ore, leaving 0.538 dwt. in the residue.

A research by K. L. Graham and F. Wartenweiler, discussed in an Institution bulletin, raises the important question as to the size to which gold must be ground to insure efficient extraction during the limited time of agitation treatment by the all-slime process. The answer—minus 260 mesh—deflects attention to the fact that (1) the isolation and separate grinding of the gold is impracticable; (2) the excessive fine grinding of the gangue is not only expensive but provocative of inefficiency in any system of solution displacement adopted, and (3) other methods are available to extract coarse gold before cyaniding is begun.

Another unit to operate the Halvorsen process for recovering cyanide from waste solutions (U. S. Patent No. 1,486,137, March 11, 1924) was put in operation at a large Mexican plant late in 1924. The systematization of a method of regeneration, the basic principle of which has long been recognized, marks a

step forward in cyanide metallurgy that disallows a much-discussed objection to milling in alkaline water instead of in cyanide solution. It is interesting to note that according to official reports, at the Dome mine, in Canada—where the ore is milled in alkaline water, and the pulp amalgamated, thickened, and then cyanided—the recovery is higher, the tailing loss is lower, and the consumption of cyanide is less than where similar ore is being treated elsewhere by an alternative process involving milling in cyanide and the avoidance of amalgamation. The history of an unsuccessful attempt to introduce milling in cyanide in India is but one interesting feature of a scholarly contribution to the literature of the subject of gold-ore treatment, by R. H. Kendall and A. F. Hoskings, in the November, 1924, bulletin of the Institution. Preliminary amalgamation recovery at Indian plants (up to 79 per cent of the original value) is largely responsible for the excellent metallurgical results obtained without the expense of all-sliming—over 98 per cent total recovery, with a residue loss estimated to have been equivalent to under 25c. per ton.

A significant advance in solution displacement practice in 1924 was the successful application by B. D. Kelly (*Mining Journal-Press*, Oct. 11, 1924) of the idea of series filtration of pulp on vacuum filters, and the repulping of the cake with wash solution or water between the units. The development of several types of continuous thickeners, in which the efficiency of inspissation is raised by the formation and freeing of cake by vacuum and pressure, respectively, as exemplified in the Oliver-Borden and Gunter machines, whereby a high-density underflow is obtainable, promises to revolutionize practice by permitting a more efficient dewatering of water-milled, metal-impoverished ore pulp prior to and during cyanide treatment. A novel method of increasing the capacity of an Oliver filter used for dewatering is noticeable at one of the Mother Lode plants, where additional pulp is fed onto the top of the drum.

The vicissitudes of the United Comstock Co. in its attempt to treat a physically rebellious and low-grade silver-gold ore have been recorded. Trouble arose because of inefficient thickening, faulty physical composition of the material being leached by gravity with a contaminated solvent, and insufficient agitation. The extraction was raised by (1) finer grinding and better classification, (2) the removal of the trays in the thickeners, (3) the provision of additional agitators and (4) the use of a clear solution for leaching. Drastic reduction in cyanide consumption, from 3½ to 1 lb. per ton of ore, was effected by lowering the strength of the solution in the ball mills. The record for October, 1924, just prior to the absorption of the venture by subsidiaries of the Consolidated Goldfields company, reflects the result of reorganization: Tonnage, 51,150; heads, $4.177; actual recovery, 90.6 per cent; operating cost, $2.774 per ton.

Pyrometallurgy

Improvements in Smelter Details Described

By E. H. Robie
Assistant Editor, *Mining Journal-Press*

E. H. Robie

MAJOR CHANGES in the processes or equipment of pyrometallurgy are made slowly. In recent years the most outstanding are: (1) the development and almost exclusive use in America of the mechanically rabbled roasting furnace of six to eight superimposed hearths for copper and lead ores, and now also being applied to zinc; (2) the use of sintering machines of the Dwight-Lloyd type instead of H.-H. pots for preparing lead ore for blast-furnace smelting; also, to some extent, for copper and zinc ores; (3) adoption of the Cottrell electrostatic process for precipitating the solid particles in smelter and refinery gases, instead of excessive settling area in flues, wire-hung dust chambers, and baghouses, though the last named still have a place; (4) the development and increased efficiency of large reverberatory furnaces, fired by pulverized coal or oil and equipped with waste-heat boilers, for copper smelting, superseding blast furnaces; and (5) the use of large converters for copper matte, lined with magnesite brick, with improved method of feeding flux and ore and of operating.

Recently, advances in hydrometallurgy have been somewhat more spectacular than those in the practice of pyrometallurgy. It has even been said that no more smelters, especially copper smelters, are likely to be built, and that most of the present plants will be scrapped in ten years. This is an extreme view, but the tendency toward leaching, with or without roasting, and precipitation by chemical or electrolytic means, is well marked, especially for the treatment of complex ores.

The last year has seen more new construction and extensive repairs to existing plants than has occurred for several years. Of chief importance, perhaps, was the completion of the Magma copper smelter, at Superior, Ariz. A feature here is the arrangement for the pumping of flotation concentrate from the mill to the smelter, where the filters are placed. Five Herreshoff roasting furnaces are installed, one 20½ by 96-ft. oil-fired reverberatory, two 12-ft. upright converters, and a straight-line casting machine. For one month, the Magma reverberatory has averaged 420 tons of solid charge per day with a fuel-oil ratio of 0.58 bbl. per ton. With a charge containing about 12.5 per cent copper, and 13 to 16 per cent sulphur, a 39 per cent matte was made, the slag containing 0.36 per cent copper, 24 per cent iron, and 46 per cent silica.

The Mammoth smelter of the U. S. Smelting, Refining & Mining Co. at Kennett, Calif., and the copper department of the Trail, B. C., smelter, resumed operations during 1924, and the American Smelting & Refin-

ing Co. is erecting a copper smelter at San Luis Potosi, to take the place of the Aguascalientes plant. The Old Dominion smelter, a blast-furnace plant, at Globe, Ariz., has been closed down. The British America copper-nickel smelter in the Sudbury district has also ceased operations—another blast-furnace plant.

Several copper smelters and refineries are spending large sums in reconstruction and improvements. The Calumet & Arizona smelter at Douglas has had the concentrates from the new New Cornelia mill to handle, and the smelter production has been doubled, three reverberatories now being in use. These are 19 by 100 ft., and in May averaged 786 tons dry charge per furnace day, using 0.56 bbl. of oil per ton. A new sampling plant, a crushing plant, and a Cottrell plant for the roasters have been installed. The automatic sampler is built in two units and takes three cuts with intermediate crushings by a No. 3 Telsmith gyratory and 42 by 12-in. Allis-Chalmers rolls. Cuts of 4, 8, 12, or 16 per cent may be taken, which allows great flexibility in the size of the final sample. The crushing plant reduces mine-run ore to a maximum of $\frac{5}{8}$ in. for the roasters. Equipment includes two No. 8 Gates gyratories, two sets of 78 by 24-in. Traylor rolls, and six 8-ft. Hum-mer screens. The main feature of the plant is the extreme flexibility of the roll operation, one set of rolls doing fine crushing one week and coarse the next, so that the faces of the roll shells are kept in good condition.

The new Cottrell plant at the C. & A. smelter replaces a large dust chamber. It is of the plate type, designed to treat 500,000 cu.ft. of gas per minute, and contains five sections with four banks of electrodes in each. The discharge electrodes are $\frac{3}{8}$-in. twisted rods spaced 6 in. center to center, and the collecting electrodes are of No. 16 gage corrugated iron. The power delivered from the transformers has a range of 30,000 to 50,000 volts, in steps of 5,000. A screw conveyor system transports the collected dust from the hoppers to a central loading hopper, from which it is hauled to the furnaces in calcine cars. Several other Cottrell plants have been installed during the year, the Cottrell system being generally accepted as the best method of precipitating smelter and refinery dust. These installations include a model plant at the Bunker Hill & Sullivan, one at the Torreon smelter of the American Metal Co., and a plate treater for the Cerro de Pasco converter gases. Much better results have been secured by paying more attention to conditioning the gas properly, temperature and humidity being important. Particularly valuable work, the results of which have not been published, has been done at the Tacoma, Garfield, and Omaha plants of the American Smelting & Refining Co.

Blast Furnaces Going Out of Fashion

Blast furnaces for copper smelting continue to go out of fashion. They are no longer used by the Calumet & Arizona, Anaconda, and Cerro de Pasco, among other old blast-furnace plants, and also will be discontinued at the U. S. Metals Refining works at Chrome, N. J. On the other hand, two blast furnaces are being installed at the Torreon lead smelter to handle copper secondaries. Apparently, there is nothing new in introducing powdered coal through blast-furnace tuyères. The practice has been abandoned, possibly for legal reasons, at the Midvale smelter, where it was successfully used on lead furnaces, and I believe no copper smelter is now using it. Further progress has been made in the mechanical charging of reverberatories at the Copper Queen smelter at Douglas, where both sides of a reverberatory have been equipped with means for forcing calcines through openings in the side walls, but the installation is still on an experimental basis. Further fuel economies have been made at the Cerro de Pasco smelter, where as little as 0.32 bbl. of oil per ton of ore (hot calcines) is reported. Excess air is carefully excluded by sealing up all holes. This fuel economy is phenomenal compared with the practice of other plants. At the International smelter at Miami, two 120 by 21-ft. furnaces have averaged 578 tons per day with a fuel ratio of 0.52 bbl. of oil per ton of charge. At Copper Cliff, the new 112 by 20½-ft. reverberatory has averaged 606 tons of charge (only 57 per cent of which was hot calcines) per day, using 96 tons of powdered coal, a fuel ratio 6.3 to 1. In addition 105 tons of liquid converter slag per day is poured in.

The Calumet & Hecla company has installed powdered-coal equipment of Raymond make for its smelting and refining furnaces. The plant has a capacity of 120 tons of coal in ten hours. Compared with hand firing, it saves about 35 to 40 per cent in coal consumption and increases furnace capacity by 50 per cent. Litigation on the side feeding of reverberatories (Carson patents) has reached the Federal Appellate Court, where a decision may be forthcoming this year.

Ten Dwight & Lloyd sintering machines have been installed at Cerro de Pasco to roast lead concentrates. A new opening for sintering machines may be found in the Ducktown district of Tennessee; here iron and copper sulphides are separated by selective flotation, and it is planned to recover and sinter the iron sulphides, making acid from the gas, and by removing the sulphur to obtain a product that can be shipped as a high-grade iron ore. Both the Tennessee and Ducktown companies are working along this line, and the work, if successful, will no doubt have application elsewhere. Sintering of copper ores has also been proposed, under certain conditions, a dead roast to be obtained, followed by blast-furnace smelting of the sinter to give black copper. This would avoid converting. Black copper has actually been made from refinery slag near New York City, by this method, a slag being produced containing 0.4 per cent copper and less. In Florida, sand phosphate has been sintered, previous to electric treatment, by the American Cyanamid Co.

The Nichols Copper Co. made several improvements at its Laurel Hill smelter and refinery near New York during 1924, including a modern sampling mill, a 100-ton D. & L. sintering machine, and mechanical charging equipment. The electrolytic refinery, which operates on the series system, is also doing better work than formerly, a much wider limit in the impurities present in the electrolyte being permitted. About $1,250,000 is being spent at the Chrome, N. J., smelter and refinery of the U. S. Metals Refining Co. A new reverberatory and ore bins are being built and a powdered-coal system, with Fuller equipment, will be used for both smelting and refining furnaces.

In lead smelting, the most important construction in 1924 was the enlargement of the Federal Lead Co.'s smelter, near Alton, Ill. Though production did not rise much above 10,000 tons per month in 1924, the ulti-

mate capacity will be 3,000 or 4,000 tons greater than that. The new equipment includes additional Newnam hearths, blast furnaces, roasting and refining apparatus, including 110-ton kettles; also, casting and car-loading equipment similar to that developed by W. E. Newnam at Collinsville.

The American Metal Co. is operating six lead furnaces at Torreon and four at Monterey, where a new charging system is to be put in. An interesting feature of the Monterey practice is the molding of bullion in two-ton blocks in which an iron hook is set, the block then being picked up by a crane for melting. Considerable progress has been made in lead refining. The Harris process was mentioned in last year's review. The present practice has departed somewhat from the original patent specifications; it is understood that the reagent now used is a mixture of caustic soda and niter cake. It is being used in the United States to refine scrap lead at a small plant at Matawan, N. J., and an installation at the Perth Amboy refinery of the American Smelting & Refining Co. has just been completed. No results are yet available. The American Metal Co. is also putting in the Harris process at its Monterey refinery. The U. S. S. lead refinery at Grasselli, Ind., has developed a somewhat different method of refining, using caustic soda for removing the impurities from antimonial lead without the accessory equipment used in the Harris process. Details are not yet released. This company has also completed a new parting plant at Grasselli, using horizontal cells, patterned after the Pachuca installation. Formerly the doré bullion was shipped to Chrome.

New Types of Crucibles in Use

New types of crucibles are coming into use at Grasselli, Chrome, Raritan, and Baltimore, those of graphite being superseded by a more refractory composition, probably chiefly aluminum silicate. A glazed graphite crucible has also been perfected. Longer life for the crucibles and less care in pre-heating and drying are secured.

The International lead refinery is now using a mixture of water gas and byproduct coke gas as a fuel for its retort furnaces, and finds the bottles last much longer, so that this fuel, though more expensive than coal, gives lower costs. The softening and refining furnaces are still hand fired, with coal. Powdered coal is used at Midvale, and on the refining furnaces at the Bunker Hill & Sullivan. The U. S. S. refinery has recently changed from coal to oil for firing under the kettles, with satisfactory results. The management merely covered the old fire box with brick and tilted the oil burners downward, using low pressure. Oil has been used at the Omaha refinery for several years.

At the St. Joseph Lead Co.'s works sulphur is now stirred into the kettles, to assist in the removal of impurities other than antimony and bismuth. This has not been done at this plant before.

A few improvements have recently been made in minor details of zinc retorting, so that furnace capacity has been noticeably increased and costs have been lowered. At most of the plants, costs vary from $15 to $20 per ton, though where natural gas is available and it is given a nominal value, a cost of $12 or less may be attained. Zinc metallurgists are showing more of a tendency to break away from old traditions. Autogenous roasting has been satisfactorily accomplished in two modified Wedge furnaces (Ord furnaces) at the American Zinc, Lead & Smelting Co.'s plant at Columbus, Ohio, in connection with a Cottrell treater, and as details are perfected further installations in the United States may be expected. The Vieille Montagne works in Belgium, I believe, has contracted for one or more of these furnaces. Gilbert Rigg's idea of blast roasting has been followed at the National Zinc Co.'s plant at Bartlesville, where a Dwight & Lloyd sintering machine is reported to be doing satisfactory work on a pre-roasted blende containing 9 to 10 per cent sulphur. I understand that Mr. Rigg is now installing sintering machines in England, following Australian practice. Spirlet furnaces may be used there for the pre-roasting. Sinter makes an excellent charge for retorts. Sintering machines have also been installed to follow the McDougal roasters at the Bully Hill zinc oxide plant in California.

Successful Electrothermic Smelting

Electrothermic smelting continues an apparent success in Norway and Sweden, with further progress reported from the Trollhättan works. Professor Fulton has carried on further laboratory work at the Missouri School of Mines. With ores rich in associated metals, this method of treatment may have a future; a combination of retort and electrothermic smelting has also been proposed. The retort process, however, is far from being decadent, and further improvements will be made. A novel method of charging of which we may hear more in 1925 is being tried out; it is simple and looks attractive. Most of the mechanical charging machines so far used have as many faults as virtues.

The new Rosita zinc smelter of the A. S. & R., in Mexico, now under construction, must be mentioned. This is a byproduct coke plant, the gas being used for firing the zinc furnaces, and sulphuric acid being also made. The A. S. & R. recently completed another gas fuel plant at Amarillo, Tex., natural gas being used there.

The clay situation is worrying certain zinc smelters. The St. Louis clay beds are beginning to be worth more as real estate than as a source of clay, and other deposits of suitable plasticity and refractories are none too common. An entirely new material may be developed for retorts.

Several white-arsenic plants have been built in the last year or so, both for treating raw arsenical ores and flue dust. The process is simple, a small reverberatory or multiple-hearth roaster with external firing being used to volatilize the arsenic, and an extensive flue system for condensing. Refining is a repetition of the process. Arsenic is now being refined at Mapimi and the new plant at San Luis Potosi in Mexico, and at Tacoma, Wash., Denver, Colo., Tooele, Utah, Peyton, Calif., Anaconda and Jardine, Mont., and at a recently constructed small plant at Keystone, S. D.

Volatilization methods for treating certain ores have received considerable attention in the West. At the Chief Consolidated, Eureka, Utah, for example, a mixed oxide and sulphide lead-copper tailing containing precious metals is dried and charged, without reagents, into a rotary kiln, 10 by 80 ft., fired with pulverized coal, the fume from which contains the lead, gold, and silver and is completely collected in a baghouse.

Metallurgy of Iron and Steel

Noteworthy Advances in Technology in 1924

By Bradley Stoughton
Professor of Metallurgy, Lehigh University, Bethlehem, Pa.

Bradley Stoughton

ALTHOUGH only about 13 per cent of pig iron made in the United States is cast in sand at the blast furnace, the mechanical pig-bed molder[1] will be interesting to many plants. It consists of a rotating rectangular frame having four series of outside teeth. The frame is the length of the pig beds and is dragged through the sand toward the furnace, leaving a series of molded imprints of pig bed and sow, each identical with the others and exactly spaced. By means of the pig-bed molder, in connection with the pig breaker, much of the hard hand labor at the blast furnaces is eliminated. Increased blast volumes continue to prevail, especially in districts using lean ores, and 60,000 cu.ft. per minute is no longer considered exorbitant in blast-furnace practice. The same is true of large hearth diameters of 18 to 20 ft. Both conditions yield higher tonnages per furnace. Another helpful factor is high blast temperatures, which are now commonly up to 1,400 deg. F., with stove temperatures of 1,600 deg. An additional advantage of high blast temperatures is fuel economy, especially when uniform blast temperatures are maintained. Additional installations of automatic blast-temperature regulators, which, by means of thermostats controlling a motor, adjust the proper mixture of hot and cold air, are being made. The more general use of the Chance process of coal washing[2] has resulted in a better grade of coke of lower ash and sulphur content. The importance of regularity in coke analysis, structure, combustibility,[3] and size in promoting furnace efficiency and economy is recognized.[4] Mention should especially be made of a study of the effect of sulphur in the coke on the cost of pig-iron manufacture.[5]

The outstanding contribution of 1924 in the study of blast-furnace slags is the model constructed by Prof. R. S. McCaffrey,[6] making clear the ultimate composition of slags and establishing the fact that some of our conceptions of slags, such as the equivalency of lime and magnesia, are in error. This seems to be a first step in the scientific explanation of slag constitution. The utilization of the 20,000,000 tons of slag produced annually in the United States continues to expand, so that now about 60 per cent of the slag produced is sold commercially.[7] Two new processes are reported from Germany. One involves the making of a better slag brick by producing an artificial pumice or slag froth;[8] and the other consists of a method of making tubes by molding sections with suitable joints. The slag for these tubes is molded without binder and they are said to be strong.[9]

Progress is reported in the extent to which blast-furnace gas is cleaned and in understanding the scientific and economic considerations of wet and dry-cleaning processes.[11] Gas purified by wet methods has less sensible heat, but nevertheless produces a higher temperature in the stoves, while the dry-cleaning process is less costly in operation.[10] The Cottrell precipitating process has been installed at a large plant. This is the third in the United States, and there are several in Europe.[12]

The practice of desulphurization of cast iron in the ladle by means of sodium salts, chiefly fused sodium carbonate, is increasing, and results of specifications and tests for the more efficient purchase and use of foundry sand are being gradually reported. A new type of cupola using preheated blast is reported from Germany and is said to give 30 per cent increased thermal efficiency as well as a higher temperature of iron and slag.[13] The centrifugal casting process has made real progress,[14] although not yet fully established as a standardized commercial process.[15,16] Encouraging reports continue to be made[17] concerning the improvement in the properties in cast iron in the form of the so-called pearlitic cast iron.[18]

The subject of thermal efficiency, heat economy, and waste heat recovery in open-hearth furnaces still occupies the largest share of attention.[19] Within recent years the heat loss has been reduced from 80 to 30 per cent and the amount of heat absorbed by the bath has been increased from 9 to 16 per cent.[20] The possibility of recovery of waste heat has made it commercially advantageous to reduce the unrecoverable heat escaping from the furnace by radiation and conduction.[21] This has led to better heat insulation. A corollary of this is the necessity for a higher grade of refractories[22] so that the lessened cooling of the bricks, due to heat insulating, shall not result in fusing them. These conditions enable thicker side walls to be used on the larger-sized furnaces. Improved combustion can be obtained in these furnaces. The center of the roof is, as before, made of one course of brick, because of the intense temperature at this point, but additional roof thickness is provided at the sides. One large manufacturer, however, is using water-cooled dampers which can be lowered so as to close the upper part of the port when it is being employed as an entrance port, thus keeping the temperature away from the roof. The use of water cooling continues to increase steadily. It is an interesting observation, not previously pointed out so far as I know, that water cooling does not always result in increased loss by radiation, because the cooler the insulating material the less heat it will conduct and therefore the less will be the radiation loss due to that cause. A new furnace-end is reported to have given improved results in German practice[23] by securing a

better mixing of gas and air, increased economy of construction, operation and repair, and increased speed of furnace refining. Additional evidence is presented of the absorption of sulphur during the melting-down stage.[24] This is corroborative of previous results, but is worthy of note, since considerable difference of opinion upon the subject has been expressed.

The outstanding features of electric furnace practice[25] are the further increase in the size of successfully operating furnaces up to a present maximum of 60-ton units, and the development of the electric pig-iron furnace, previously only operated with a closed top and now said to be successfully operating with open-top construction.[26] A new electrode of a more durable kind is reported from Remscheid.[27] Lastly, two large electrolytic iron plants are in process of erection.

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REGIONAL SUMMARIES

United States

Excellent Outlook as the Year Closed

By Arthur B. Parsons
Assistant Editor, *Mining Journal-Press*

GOLF is an institution of varied virtues; one is the existence of "par." It is comforting to know just how good your game is, or at least to know how far it falls short of being good. Some such standard measure or index for the mining industry would be a great convenience, but there is none. The best we can do is to make the orthodox comparison of sundry statistics with those of the preceding year. The accompanying table shows some of the salient figures for 1924 and 1923, and corresponding data for the war year of 1917. Although the latter are abnormal, and accordingly have no particular significance, the comparison may not be without interest.

The outstanding feature of 1924 is not disclosed in the figures: that is the highly favorable situation that exists at the close of the year. The industry was much more prosperous in 1923 than in 1922, and, all things considered, 1924 was a better year than 1923. By analyzing the statistics and supplementing the bare figures that are shown here with other evidence I shall attempt to justify this statement.

Earnings—The division of the important dividend payers into two groups, one composed of copper producers and the second of producers of the other metals, gives figures that reflect fairly well comparative prosperity. Virtually the only copper company to increase its dividends materially was United Verde, which paid $3,300,000 in 1924, or about $800,000 more than in 1923. Anaconda alone accounts for $6,750,000 of the aggregate decrease in dividends, as it made only one quarterly distribution. On the other hand, some of the companies drew upon surplus to continue dividends that were not actually earned. It must be remembered also that companies like Ray, Nevada Consolidated, Old Dominion,

Arthur B. Parsons

and Quincy, once big earners and still important producers, are conspicuously absent from the roll of dividend payers both for 1923 and 1924. Of course, the comparatively lean period in the last half of 1923 and the first part of 1924 discouraged dividends in 1924, whereas the better earnings of the closing months of 1924 will be reflected in distributions of the present year. Anaconda already has announced a regular 75c. payment for February, and others, notably Kennecott, are expected to increase dividend rates. Among the non-copper group significant increases were made by Homestake and Golden Cycle, both gold producers; and by Tintic Standard, Silver King Coalition, and Bunker Hill, whose principal revenues come from lead and silver.

The figures showing the appraisal of mining shares by the public, as registered in the average closing quotations, reveal the fact that "coppers" were able to finish the year on even terms with the others. At least it is not a bad sign to have the Stock Exchange think well of you.

Earnings necessarily depend in a large measure on the market price of the metals. As shown in the table, the yearly average for copper was 1.4c. below that of 1923, and zinc lacked ¼c. of the 1923 average. Lead, on the other hand, was much better, and so was silver, if the Pittman Act price of the first half of 1923 is not taken into consideration. Incidentally, that six months of dollar silver in the first half of the year was a handicap in favor of 1923 that must be considered in comparing earnings. The outstanding feature of the market situation is this: Copper at 14.65, lead at 9.70c. and zinc at 7.75c. in the final week brought more than at any other time during the year, and silver at 66.75c., though considerably below the high October average of 70.827c., was fairly satisfactory to the producer.

It must be admitted that copper producers in the United States, as a group, cannot make much money with copper at 13.02c., which was the average price for 1924. The buoyancy in the closing months of the year, based on sound economic reasons that are dwelt upon elsewhere in this issue, is one of the big factors that do not appear unless monthly statistics are examined.

Though the nominal base price for iron ore in the Lake Superior region was only 80c. below that of 1923, independent producers realized considerably less on most of the small tonnage of non-contract ore that was moved. This will be mentioned presently.

Production—Healthy operating conditions at the mines are indicated by production figures, with the single exception of iron mining. The general depression in the steel industry during the summer and early autumn naturally reacted on iron-ore shipments, and production from both open-pit and underground mines was curtailed greatly, especially in the Lake Superior region,

where many mines were shut down and others operated far below capacity. For example, the Mesabi Iron Co. suspended production entirely, at Babbitt, Minn.; and both Pickands, Mather and Oglebay Norton curtailed sharply in Michigan.

Lead output, 8 per cent higher in 1924 than in 1923, has been limited by three things: Ability to find ore, to mine it, and to mill it. In Southeast Missouri the St. Joseph Lead Co. now is able to produce around 28,000,000 lb. of lead per month as a consequence of its acquisition of the Federal holdings. Important operating economies have been effected by the consolidation of the properties. The situation in the San Juan region, in Colorado, is rather precarious. Although a good total production was maintained all year, the Atlas and Black Bear have been shut down temporarily and the Tomboy and Smuggler-Union are operating with only a few months of ore ahead of them. The Sunnyside mine, on the other hand, looks better than heretofore, and steady and high production is assured. In Utah lead-ore shipments have been high, particularly in the latter part of 1924, and the Murray, Midvale and Tooele smelters are handling large tonnages. In the Coeur d'Alene district, in Idaho, the resumption of the Hecla company in January, after the fire of July, 1923, and the opening of a new orebody by the Ajax, aided by the stimulation of the excellent metal market, swelled lead production measurably.

Vigorous efforts to promote "voluntary" curtailment in the Joplin-Miami district had some effect in keeping zinc output down during the summer, but the high rate of recent months has broken all output records for the district. In the Rocky Mountain states production declined slightly.

A feature that is highly significant to all of the Western states is the putting into operation, late in the year, of new plants for the treatment of lead-zinc ores. The A. S. & R. Co. has taken over the operation of the Sulphating plant at Durango. It has arranged to treat Sunnyside middlings, and is prepared to buy other lead-zinc products on a custom basis. At Tooele, Utah, the International Smelting Co. has remodeled the old Utah Consolidated flotation plant to float differentially zinc-lead ores from customs shippers, thereby affording a market for certain classes of ore that could not be shipped heretofore. The Combined Metals Reduction Co., financed by the National Lead Co., has recently started a hydrometallurgical plant for the recovery of lead from a zinc-lead tailing. The primary source of ore is the Combined Metals mine at Pioche, Nev., but customs ores can be handled. In Idaho, the Bunker Hill company is prepared to erect a combined zinc-lead leaching and electrolytic plant, at Kellogg, to treat Star ores and custom ores from tributary territory; and at Great Falls the Anaconda company has appropriated $350,000 for increasing the capacity of its electrolytic zinc plant in anticipation of increased production of "complex" ores. Although the primary consideration may be to unlock the lead in these zinc-lead ores, the zinc must be recovered too if the processes are to be profitable. These important activities should be reflected in increased zinc production in the West in 1925. So far as I know, no ore buyer ever paid for both zinc and lead in the same ore before 1924; in this respect 1924 is an important milepost.

The fact that gold production increased in 1924 and that the decline in silver output was comparatively small is accounted for by the augmented production of lead and copper ores that contain precious metals. An appreciable drop in silver output was to be expected on account of the abnormal rate induced by the Pittman Act in 1923. This was in a measure realized in the "all-silver" districts, although Tonopah, Nevada's premier silver district, is very much alive, indeed. The Tonopah Extension marketed bullion worth nearly $2,500,000. The Tintic Standard mine, in Utah, was the leading producer in the United States of silver from typically silver ore.

Gold production at the Homestake, in South Dakota, and from the Cresson and Portland mines, in Cripple Creek, Colo., increased; California alone of the states producing gold from "gold" ores failed to come close to its 1923 record.

Although mine production of copper increased 7.4 per cent compared with 1923, the aggregate of the year was under 80 per cent of the efficient capacity of the present mine and ore-treatment plants. With a display of self-restraint for which they ought to be complimented, the "low-cost" producers in general maintained curtailed rates of output synchronizing with those of their less-fortunate fellow producers in Michigan and at Butte.

Utah Copper, for instance, could doubtless turn out upward of 22,500,000 lb. of copper in a month without spending a dollar for new equipment, but during most of 1924 it has averaged about 18,000,000 lb. The object of curtailment, of course, was to help the market.

If in 1925 the copper industry, as seems likely, is to come into its own, it certainly is prepared to take full advantage of the opportunity. During the lean years of the recent past it has spent money, unstintingly, to be ready. The Phelps Dodge Corporation, Calumet & Hecla, and Nevada Consolidated are cases in point. The last-named company has its new concentrator, with a capacity of 15,000 tons of ore per day, completed. It has increased the capacity of the crushing plant, the roasting and converting departments of its smelter, and the power plant. During the third quarter of 1924 the new concentrator made the remarkable recovery of 20.69 lb. of copper per ton from 1.18 per cent ore, as against 20.26 lb. from 1.51 per cent ore in 1918. The average grade of the ore reserves is much better than 1.18, so that when capacity production becomes desirable

Statistics on the Mining Industry in the United States

	1917	1923	1924	Per Cent Change 1924 over 1923
Total dividends twelve copper companies	$110,315,000	$32,105,000	$22,216,000	30.5 *D*
Total dividends twenty lead, zinc, silver, gold companies	55,941,000	33,400,000	36,797,000	10.2 *I*
Average closing quotations, fifteen copper companies	39⅞	25⅛	35¼	40.0 *I*
Average closing quotations twenty lead, zinc, silver, gold companies	37⅞	28⅞	40½	40.0 *I*
Gold production, oz.	3,981,000	2,485,000	(a) 2,511,000	1.0 *I*
Silver production, oz.	71,740,000	66,163,000	64,792,000	2.1 *D*
Average silver price, cents	81.41	(b) 81.90	66.78	18.5 *D*
Copper production, tons	959,000	739,000	794,000	7.4 *I*
Average copper price, cents	27.18	14.42	13.02	9.7 *D*
Zinc production, tons	585,000	508,000	515,000	1.4 *I*
Average zinc price, cents	8.73	6.61	6.34	4.1 *D*
Lead production, tons	579,000	567,000	610,000	8.0 *I*
Average lead price, cents	8.78	7.27	8.10	11.4 *I*
Iron-ore production, tons	75,000,000	70,000,000	54,000,000	26.6 *D*
Lake Superior base price for Old Range Bessemer, dollars	5.95	6.45	5.65	12.4 *D*

(a) Production figures for 1924 are based on preliminary estimates of U. S. Geological Survey.
(b) Excluding Pittman Act silver, this was 64.87c. *D*, decrease; *I*, increase.

Metal Production of the United States 1923 and 1924

(All Figures by U. S. Geological Survey; Those for 1924 Are Preliminary Estimates)

	Gold		Silver, Oz.		Copper, Lb.		Lead, Lb.		Zinc, Lb.	
	1924	1923	1924	1923	1924	1923	1924	1923	1924	1923
Alaska	$6,350,000	$6,401,100	674,000	687,900	95,500,000	68,648,000				
Arizona	4,840,500	6,049,700	6,270,000	7,239,100	676,000,000	615,493,000	17,800,000	17,656,000		520,000
California	12,973,000	13,541,100	3,338,000	3,740,700	53,330,000	27,042,000	5,160,000	10,336,000	2,380,000	
Colorado	8,494,000	6,501,200	3,248,000	5,607,100	2,849,000	4,343,000	46,022,000	47,770,000	59,205,000	53,560,000
Idaho	549,100	750,500	8,048,000	7,832,000	2,430,000	3,664,000	256,500,000	255,594,000	16,000,000	27,952,000
Michigan			153,208	253,000	128,000,000	137,691,000				
Montana	2,006,800	1,759,600	13,370,000	14,191,500	250,182,000	224,353,000	37,712,000	36,690,000	123,000,000	141,460,000
Nevada	4,700,000	4,305,700	9,500,000	10,507,000	80,400,000	63,495,000	19,400,000	16,088,000	11,500,000	14,168,000
New Mexico	521,000	487,100	839,000	778,400	73,900,000	57,521,000	4,800,000	3,276,000	20,000,000	16,496,000
Oregon	556,000	477,200	41,400	64,400	781,000	1,182,000				
South Dakota	6,135,000	6,283,900	91,000	93,400						
Utah	3,038,000	3,257,200	17,000,000	20,275,700	242,700,000	210,118,000	231,425,000	209,356,000	16,000,000	11,330,000
Washington	284,000	317,000	193,500	220,000	944,800	839,000	3,650,000	4,016,000	1,024,000	3,024,000

the company is in position to reap the benefit.

Phelps Dodge, in like manner, has its new Copper Queen concentrator and the remodeled No. 6 plant at Morenci in readiness to do much more than they are doing now. Calumet & Hecla has its new Tamarack reclamation plant ready to operate and its new 81st level haulageway finished and equipped; it has equipped the smelter with a new coal-pulverizing plant, and has started construction on a new 9-mile standard-gage railroad. Other companies are in much the same position. The year has been one of patient marking time; but when the order is given to go ahead there ought to be a lot of copper made right here in the United States that will rival in low cost some of the so-called cheap copper of foreign countries.

Organization—The year 1924 marked some further progress toward concentration of control to attain more economical production. Anaconda bought the Davis-Daly property as the most sensible way to settle pending apex litigation, and likewise (through the International Smelting Co.) acquired by foreclosure the assets of the Utah Consolidated company, including the Highland Boy mine, at Bingham, and the concentrator at Tooele. The purchase of the holdings of the United Comstock Mines Co., at Virginia City, Nev., by the Comstock Merger Mines Co., marked the end of an ill-fated enterprise. The purchasers, who have a good tonnage of ore but no mill, got for $600,000 a modern cyanide plant and a long haulageway that represent an investment of several million dollars, and some low-grade ore. The operation of the combined properties will be watched with interest. The purchase for $1,500,000 of the Moses-Childress holdings in the Joplin-Miami district has put the Federal Mining & Smelting Co. in first place among the producers of zinc concentrate in the Tri-state field.

The merging of Ray and Chino, in Arizona and New Mexico, was effected early in 1924. Since then Wall Street has been waiting impatiently for the announcement that Ray has been absorbed by Inspiration; in fact, the Street has gone further and included Phelps Dodge in a big new company comprised of all three. The Phelps Dodge officials have publicly declared that the company has "no intention of disposing of its mining property." It need not, of course, do that to go into a merger.

Industrial Relations—Few changes in wage scales were made during 1924. Generally speaking, pretty fair equilibrium exists between supply and demand at the present wages; if anything, more experienced men are available than there were a year ago. A good deal of work is done on a contract or bonus basis, and instances are numerous where earnings average from $6.50 to $8 for a large proportion of the men on the payroll.

"Better schools, better homes, better clubs—make better workers" seems to be the slogan for several progressive mining companies. They are doing their share to further this end by providing better buildings. Arizona mining districts abound in fine school structures. Both the United States and Utah Copper companies have erected brick and concrete buildings to replace many of the frame shacks that made a firetrap of Bingham, Utah; and the United Verde is building twenty modern houses at Jerome, Ariz.

Costs—Mine conditions being equal, operating costs ought to be lower today than they were a year ago. Wages are no higher, and the individual efficiency of the worker should be greater in view of the increased supply. Manufacturers are steadily improving the mechanical equipment that is required, thereby increasing still more the effectiveness of the worker. Current prices of mine supplies and materials, with few exceptions, are virtually on a par with January, 1924. The decrease in federal taxes has been a notable factor in cutting costs. Certainly there has been progress in the development of better methods in mine, mill, and smelter; and costs should show a corresponding improvement.

The accompanying table shows the production of the principal metals by states according to the preliminary estimates of the U. S. Geological Survey. In addition to the facts they tell, I will mention some of the significant events and tendencies in the more important mining regions.

California—Though earnings were not great, the larger lode gold mining companies are optimistic enough to deepen their shafts. The Plymouth, Central Eureka, Argonaut, Kennedy, and Moore all sunk further during the year. Twenty gold dredges are in operation. Copper production totals about 50,000,000 lb. a year; Engels, which has finished its long haulageway, is the second largest contributor, and Walker, with its new 500-ton flotation plant, started last January, is third; U. S. Smelting at its Mammoth smelter is the first in copper production. California Rand Silver, Inc., at Randsburg, curtailed output during the summer; extensive development at lower levels is planned.

Idaho—The exhaustion of the Hercules mine, earner of $18,000,000 in dividends, is more than offset by important new discoveries in the Bunker Hill, Hecla, Star, and Ajax mines, in the Coeur d'Alene district. Bunker Hill made important additions to its smelter, and the Hecla company finished one of the most complete and efficient mine plants in the West. A new flotation concentrator was finished by the Hewer Mining Co., at Lakeview.

Active development of lead-silver properties in central Idaho is significant. The Bunker Hill company has an excellent prospect in the Lost Pilgrim, and no less a gentleman than Henry Ford has taken over an option on the Red Bird mine, in Custer County. Needless to say, he means business.

Nevada — Underground development to the west has added materially to the favorable area at Tonopah. The Tonopah Extension has acquired a large area in this section and plans to sink a new shaft. It also has finished the first unit of a Diesel-engine electric power plant to have a capacity of 6,000 hp. Development in new areas financed by the Tonopah Divide, Montana-Tonopah, and Belmont companies is under way. Production is the best since Pittman Act days. The Flowery Comstock started a new 200-ton cyanide plant near Virginia City. Revival at Pioche is marked by regular shipments of 250 tons per day by the Combined Metals Co. The Bluster Consolidated started a 100-ton gold mill at Jarbidge.

Utah—The completion of the new flotation and volatilization plant of the Chief Consolidated has increased output at Eureka, which had dwindled somewhat in the first half of the year. Park City shipments have been large, increased output by the Silver King Coalition, Park City M. & S., and Keystone—a new producer—contributing to the total. The Gold Hill district produced 40,000 tons of 20 per cent arsenic ore in 1924, and was the most important source of arsenic in the United States. The year also was marked by the starting of regular shipments of iron ore from the Iron Springs mines, in Iron County, to the blast furnaces at Provo. This is the first use of iron ore as a source of pig iron in the Rocky Mountain region.

Arizona—Companies in the leading copper-producing state, though they did not earn much in 1924, finished a lot of expensive construction and planned more. New Cornelia put its new 5,000-ton flotation plant into operation, and Magma Copper started its new smelter at Superior. United Verde deepened its shaft and put a splendid new crushing plant into operation; it celebrated the event soon after by producing 10,000,000 lb. of copper in a month, thereby making a new record—not excepting the best month during the war.

Inspiration finished and started using its $6,000,000 Porphyry shaft and plant, and simultaneously broke ground for a $6,000,000 leaching plant. In addition, the company signed a fifteen-year contract with the Salt River farmers for a power supply costing not less than $565,000 annually, thereby warranting the construction of the new Horse Mesa dam and hydro-electric plant. Miami has recently decided to spend $800,000 to improve its mill. Plenty of faith in copper in Arizona!

Montana—Anaconda, too, put in a year of preparation. For one thing, a vice-president who knew little about mining but considerable about business went to Montana to live in 1923. He did a lot of reorganizing, and the results of his work and other economies are said to have cut costs by $1 or $1.50 per ton. One large project started early in 1924 was the deepening of six of the company's copper shafts to about 3,500 ft., at a cost of $400,000. Progress was made in the development of zinc ore in the zinc properties operated by the company. Jib Consolidated built a 300-ton mill to treat gold ore at Basin, and at Philipsburg the Trout Mining Co. is finishing a plant to concentrate manganese ore.

Colorado—Good developments on the lower levels of the Cresson and Portland mines, with good production by

lessees in a number of smaller mines, swelled the gold output of Cripple Creek to about $6,500,000, compared to $4,300,000 for 1923. At Leadville, the Graham Park drainage project is still in hand and production is expected in 1925. A new mill has just been finished by the Ophir-Colorado Mines Co. in San Miguel County; and the U. S. Vanadium Co. is completing a modern concentrator at Rifle.

Joplin-Miami—Three companies, the Federal M. & S., the Commerce M. & R., and the St. Louis S. & R., passed the 50,000-ton mark in concentrate shipments in 1924. All records both for tonnage and value for the whole district have been broken. The gross value exceeded $41,000,000 and the zinc concentrate total was more than 730,000 tons. Developments in the Baxter Springs, Quapaw, Crestline, Pierce City and other sections of the district are good, but operators doubt whether a production of 18,000 tons per week can be maintained for a period of more than a year or two. A $60 quotation for concentrate would be necessary, they think, to induce such a production. During 1924 a dozen new concentrators were erected, and at the close 156 mines were in operation.

Michigan—Estimated total production of 128,000,000 lb. of copper (10,000,000 lb. less than in 1923) came from four companies—Calumet & Hecla Consolidated, Mohawk, Quincy, and Copper Range. This is about 50 per cent of present capacity. As in other copper districts, energy is directed to preparing for economical production when a "good" market is at hand. State taxes have been materially cut by a new basis of calculation, and rail freight rates on copper have been reduced. These are small items, but each little bit helps.

Lake Superior Iron Ranges—The dull shipping season, in which only 43,000,000 tons of ore was moved, did not deter the iron-mining companies in Michigan and Minnesota from carrying out programs of construction and reequipping in 1924. At Buhl the Hanna Ore Mining Co. completed the electrification of the Wabigon mine—shovels, locomotives, and shops are operated by electricity. Electric shovels are displacing steam elsewhere. On the Gogebic range, in Michigan, the new Geneva shaft, the Davis, Puritan, Norrie "A" and Pabst "B" shafts all were sunk or deepened; and a modern surface plant, including shops and warehouses, is being finished at the Asteroid-Eureka. A new $2,000,000 steel iron-ore dock is under construction at Allouez, Wis. Election day marked a definite upturn in the iron industry, and already predictions of shipments totaling more than 60,000,000 tons are made for the 1925 season.

Alaska—Increased production by Alaska Juneau accounted for a gold production of $6,350,000, or somewhat less than in 1923. Placer output declined, but several large modern dredges were built during 1924 and increased production is expected. Kennecott and Mother Lode copper production declined considerably, partly on account of a fire that destroyed the Kennecott power plant in August.

Canada

Greater Activities in the Gold Districts

By Reginald E. Hore

Consulting Geologist, 105 Victoria St., Toronto, Canada

CLOSER co-operation between owners of non-producing mining properties and companies which have funds available for development marked the year 1924. Both in producing areas, and in areas that are not yet producing, explorations by mining companies are now more numerous. In fact, the competition for properties was so keen that a revival of prospecting is assured.

Much interest was displayed during the year in the gold-mining possibilities of northern Quebec. Gold has been found in many townships in a belt easterly from the Ontario boundary. Rouyn and Boischatel townships have received most attention, but the area of favorable geological formations is large. Many parts are heavily covered with drift and will require laborious prospecting. However, several promising discoveries have been made already and in some instances mining companies have begun development.

The most notable discovery so far in Rouyn Township is on the property of the Noranda Mines, Ltd. A copper-gold deposit of large size has been found and is now being explored by diamond drilling. Recently shaft sinking was started. The property was found to be more valuable for its copper than for gold. Exploration is being carried on with a view to the possibilities of large-scale operation, which would require the erection of a smelter in a place now remote from railroads and far from sources of smelter fuel. The reported results to date are so encouraging that there is good reason to expect that an important industrial center will soon be established in northern Quebec. The Noranda or Horne property was staked by Edward Horne, of New Liskeard, in 1920. He found a large deposit of iron sulphide which carried gold. It was examined in 1922 and was taken under option by the Thompson-Chadbourne Syndicate. The Noranda Mines, Ltd., was formed, and the company first devoted its attention to adjacent gold properties, and then, late in 1923, began to test the sulphide deposits by diamond drilling. The cores were surprisingly good. Exploration work has been continued, and several large bodies of rich auriferous copper ore have been found.

Reginald E. Hore

The Lake Fortune gold areas, in Boischatel Township, adjoining Rouyn on the west, became prominent through discoveries made by the Alderson-Mackay Syndicate, at Lake Fortune mine. This was located in 1906, and during the next few years was under development. It was equipped with a mill, but never operated. After lying idle for a decade it was taken over and prospected by the Lake Fortune Mining Co., and rich ore was found at the lake shore. During the summer of 1924 exploration work under the lake was in progress.

On contiguous properties, notably the Arntfield, several gold discoveries have been made during the past two years. The area covered by the favorable formations and extending across Boischatel and Rouyn townships was nearly all staked out last winter. During last summer the activities of the prospec-

Daily hydroplane at Osisko Lake, Rouyn, Quebec

tors extended into neighboring townships to the north and east. One promising discovery in Cadillac Township is now being developed by the O'Brien Mines, Ltd. Several companies are operating in Rouyn Township and along the belt which extends easterly across several townships.

Good results are reported from the vicinity of Lake DeMontigny. The Stabell mine is being opened up under the supervision of R. W. Brigstock. In Bourlamaque Township, east of Lake DeMontigny, the Clark Syndicate is reported to be successful. The eastern part of the Quebec gold belt is easily reached by motor boat from Amos station on the transcontinental railroad, the Harricana River providing an excellent highway.

Transportation Facilities Have Improved

In northern Ontario transportation facilities have been improved by the construction of a branch line from Swastika into the Kirkland Lake and Larder Lake gold areas, and a branch line from near Cobalt into the South Lorrain silver area. The Rouyn area, in Quebec, is still without transportation facilities, and supplies must be carried in during the summer by motor boats operating along the canoe routes. Fortunately, a daily hydroplane service to Rouyn has been available, which permits one to reach the center of activities in one hour from the railway at Angliers, or from Haileybury. Lack of adequate transportation facilities is affecting progress. It is hoped that the Canadian Pacific R.R. will extend its line up from Angliers to Lake Fortune and Rouyn, or that the Ontario Government railway will extend its Larder Lake branch into the Quebec area.

In Manitoba, development of gold properties is in progress in the area northeast of The Pas, and also in the Bulldog Lake area east of Lake Winnipeg. The Oro Grande, which is being developed by the Anglo-Canadian Explorers, Ltd., is in the latter area. In the west work is being continued by the Mining Corporation of Canada at the Rex mine.

Porcupine an Active Gold Area

At the Hollinger the appointment of John A. Knox as assistant manager indicates the completeness of the plans of this company that are under way. A settlement of the power disputes between Hollinger and Northern Canada Power Co. is understood to have been made. At the McIntyre the sinking of a deep shaft has been begun, and is being conducted by Harry Kee as nearly independently of the mining operations as possible. At the Dome the needs of the future are difficult to forecast, and there is, therefore, less demand for increased mining facilities. Of the smaller mines at Porcupine the Vipond has advanced from an idle property of doubtful value to a producing mine with a promising future. The Night Hawk Peninsular, which looked so promising a year ago, and which gave disappointing results when production started, is in more satisfactory condition, under the management of Walter Segsworth.

At Kirkland Lake the three regular producers, Lake Shore, Wright-Hargreaves, and Teck-Hughes, are being profitably operated. The Tough-Oakes developed ore, but did not do so well as expected when milling was resumed, and changes are being made. The Sylvanite, adjacent to the Wright-Hargreaves and Tough-Oakes, has obtained good results from its recent development work. At the Kirkland Lake mine, milling has been discontinued for some time, and efforts are being made to reach greater depth, where it is hoped higher-grade ore will be encountered. The new work at this mine is under the direction of J. B. Tyrrell and is based on his geological studies. At the Teck-Hughes, D. H. L. Forbes reports good progress in opening up high-grade ore. At the Lake Shore, president Harry Oakes is in charge of operations pending the appointment of a successor to R. C. Coffey, who has resigned. At the Wright-Hargreaves and Sylvanite, Albert Wende is manager. At the Tough-Oakes, M. W. Summerhayes is now acting as consulting engineer.

Milling capacity at Porcupine will be increased considerably during the coming year. In addition to milling increases to be made at the Hollinger, McIntyre, and Vipond, new mills are to be constructed for the Ankerite and Paymaster, where development work has been in progress at a rapid rate during 1924. The West Dome mill will also be in operation. At Kirkland Lake large increases in milling capacity will be made at the Lake Shore and Wright-Hargreaves mines. Mills are to be built at Larder Lake by the Crown Reserve and Associated Goldfields companies. At Boston Creek, the Barry-Hollinger is to construct a mill in the near future.

Silver at South Lorrain and Gowganda

Of the silver-mining areas, South Lorrain and Gowganda have made the important recent advances. In South Lorrain the Keeley, Mining Corporation, and Trout Lake have all found high-grade ore. At Gowganda, the O'Brien and Castle-Thethewey are doing well. A rich orebody is reported to have been recently opened at the 600 level of the O'Brien. At the Capitol, a shaft has been sunk from which exploration work is to be begun. On other properties in South Lorrain and Gowganda exploration for silver is under way. At Cobalt, Coniagas discontinued production after the destruction of its plant by fire. Of the newer enterprises at Cobalt, the Menango has been the most successful. This company explored the old Colonial property at a depth of 1,000 ft., which is much greater than that of most Cobalt producers. Nipissing and O'Brien continue to be the chief producers. At the close of 1924, discoveries in the Gillies Limit south of Cobalt attracted attention. Many of the Cobalt silver-mining companies are now interested in mining properties elsewhere. The Coniagas has taken a property at Porcupine. The Mining Corporation has valuable properties in South Lorrain and in Manitoba. The Crown Reserve is developing a gold property at Larder Lake adjoining that of the Associated Goldfields.

The International Nickel and Mond Nickel companies are producing on a pre-war basis, but the British America Nickel Corporation has suspended operations and is in financial difficulties. The development of new outlets for nickel has received considerable attention since the great reduction in the demand of nickel for armament purposes. Little interest is taken at present in exploring for nickel deposits. The Mond Nickel Co. has, however, joined with other English interests in an exploration company that is searching for commercial gold and silver deposits.

At the Trail smelter, the Consolidated Mining, Smelting & Power Co. made a large output of lead and zinc during the year, most of it derived from the ores of the company's Sullivan mine.

Cuba

By C. M. Weld
Weld & Liddell, Consulting Engineers, 2 Rector St., New York

The hard iron ore mines of the Bethlehem Cuba Iron Mines Co. on the south coast of Oriente Province, Cuba, worked steadily during 1924. Estimated production for the year is 480,000 tons, chiefly from Daiquiri. Only about 275,000 tons was shipped, however, and there are now approximately 927,000 tons in stock at the dock. The year was not marked by any new developments or construction; 50,000 tons of soft ore was mined at Mayari on the north coast of Oriente; this was not shipped, but remains for the time being in stock at Felton.

The Matahambre copper mine, in Pinar del Rio Province, has been continuously active, with an estimated total production for the year of 24,600,000 lb. of copper and 97,850 oz. of silver. These quantities represent the contents of approximately 10,400 metric tons of hand-sorted ore (19 per cent copper and 1.5 oz. silver) and 36,740 metric tons of concentrates (25 per cent copper and 2 oz. silver). Some prospecting for copper is going on in districts adjacent to Matahambre, and the discovery of an alleged large body of copper ore on the south coast of Oriente Province is once more reported.

Small concentration tests are said to have indicated satisfactory methods for treating the gold-silver-arsenic-antimony deposit on the Isle of Pines, and it is expected to have developments under way in 1925. The Holguin gold mines have remained idle. A very little ore has been taken out of the Carlota pyrites mine.

Shipments of manganese ore in 1924 will amount to nearly 25,000 tons, almost entirely of metallurgical grade with 46 to 48 per cent manganese. This has come chiefly from Bueycito, with lesser amounts from the Cauto district north of San Luis. In addition to the above, it is reported that about 3,000 tons of 30 per cent ore has been shipped from Cristo. All these points are in Oriente Province. The Sun Development Co. reports some improvements in its concentrating mill near Bueycito.

Small shipments of chrome ore have been made from Oriente.

Drilling for oil at two points on the Becujal-Madruga uplift (Havana Province) has met with many difficulties, largely due to caving ground. Both wells have encountered gas in quantity, and in the Madruga well oil showings are said to have been constant below 2,172 ft. This well at the time of writing is 2,604 ft. deep, and the Becujal well is 2,215 ft. deep. The operators appear to have reason for being hopeful of getting profitable results when the desired horizons are reached. Small productions of light oils continue from the Bacuranao (Havana Province) and Motembo (Santa Clara Province) wells. A new oil prospect is reported from Oriente Province not far distant from Puerto Padre.

The annual tax of 20c. per hectare on mining claims has been remitted except as to active properties.

Mexico

Outlook for 1925 Promises Improvement Over 1924

By W. M. Drury

General Manager, Mining Department, American Smelting & Refining Co., El Paso, Texas

PRACTICALLY all of the established mining companies in Mexico operated continuously during 1924, and a few extended their mining and milling facilities, so as to increase their rate of production and improve their metallurgical recoveries, but a great majority of properties continued production at the same rate as followed during 1923. There was an increase in the amount of prospecting and development work, particularly in the states of Chihuahua, Sonora, and Zacatecas. The de la Huerta revolution took place during the first few months of the year, but it did not seriously interfere with the operations of established mines.

Taxes on the mineral output of mines continued upon the 1923 basis, and were so high that the average mine still paid as much in taxes as it made in the form of final net profit. Freight rates were maintained on a basis approximately 50 per cent in excess of those in effect ten years ago. The complicated labor laws enacted by the several states have not yet been rounded out into a fair and workable form, and therefore continue to be the cause of much misunderstanding between companies and their employees.

The foregoing factors continue to discourage the investment of new capital in mining in Mexico. Fortunately, however, the prevailing fair prices for silver and lead have offset the effects of the unfavorable conditions, so that the average operating mine in Mexico was able to earn a fair profit from its operations during 1924.

Chihuahua — The Ahumada district continued its regular output of good-grade lead-carbonate ore, which was smelted at El Paso. In the Santa Eulalia district the usual large amount of silver and silver-lead ores was produced, almost all of which was smelted at Chihuahua. A flotation mill for the treatment of sulphide ore from Santa Eulalia and Calera is under construction. The Mexican Northern Power Co. has brought its transmission lines into this district, and is now distributing power there. A small output of good-grade silver ore was made in the Cusihuiriachic district, where two small mills are in operation. The Parral district made further important tonnage increases. Three large concentrating mills operated on silver-lead-zinc ores, and another new mill is under construction on the Cerro de la Cruz, Parral. Two large cyanide mills operated on silver ores. The third cyanide mill was converted during the year into a flotation mill.

W. M. Drury

In western Chihuahua the Dolores mine and mill operated on gold-bearing ore, and some prospecting and development work has been done in the Concheña, Calera, Yoquivo, and Cienega districts. Considerable prospecting has also been under way in the region east of Chihuahua City.

Coahuila—In the Sabinas district the coal mines operated continuously. At Rosita a byproduct coke oven of modern type, and also a zinc smelter, are under construction. Cuatro Cienegas maintained its usual output of silver-lead-carbonate ore, which was smelted at Monterey. At Sierra Mojada, properties greatly curtailed production.

Durango—Mapimi continued its normal production of silver-lead ores until September. At that time a cloudburst flooded part of the lower workings, interfering thereafter with production to some extent. The Mapimi ores were smelted principally at Torreon. Velardeña continued its normal output of silver, silver-lead, and copper ores, which were smelted at Asarco. A small quantity of silver ore came from Promontorio and from the districts surrounding Guanacevi and Tepehuanes.

Zacatecas—At Fresnillo, further extensions were made to the cyanide plant equipment, so that an even greater tonnage of silver ore was treated than during 1923. The usual output of silver-lead ore most of which was smelted at Aguascalientes, was made at Sombrerete. At La Noria there was a small output of silver-gold ore. A power plant and mill are under construction. A small production of silver-lead ore was made from Chalchihuites. One mill at Zacatecas is in operation, and another under construction, so that during 1925 there should be an appreciable output of silver and copper. In the Mazapil and Concepcion del Oro districts the output of copper, silver, and silver-lead ore was considerable. The copper ore was smelted at Concepcion del Oro; the silver and silver-lead ore at Saltillo and Monterey.

Nuevo Leon — A small tonnage of lead-carbonate ore was mined in the district surrounding Monterey and smelted at that point.

San Luis Potosi—At Matehuala there was the usual large production of silver and copper ores, all of which was smelted locally. A small production of silver and copper ore was made. A power plant and mill are under construction. At San Pedro a small amount of low-grade silver ore was mined. An arsenic plant has been constructed at San Luis Potosi, and a new copper smelter is being erected.

Sonora—Nacozari and Cananea continued operations on a normal scale. A large amount of ore was extracted and treated at El Tigre, Tajo, and Pedrazini.

Aguascalientes—The Asientos-Tepezala district produced a small tonnage of silver and silver-copper ore, which was smelted at Aguascalientes.

Jalisco—The cyanide plants in the Hostotipaquillo and Etzatlan districts treated a considerable amount of silver ore.

Guanajuato — At Guanajuato the usual output of silver ores was maintained, the larger part of which was treated in local mills.

Hidalgo—The Pachuca district, the largest producer of silver in the world, increased its tonnage somewhat over that of the previous year. The ore was treated entirely in the local cyanide plants. The discovery of the Dos Carlos vein system proves to be one of the most important of recent years.

Mexico—A large tonnage of gold-bearing ore was treated at El Oro in the four cyanide plants.

Michoacan—A fair tonnage of silver ore at Angangueo was treated in the concentrating mill. The concentrates were smelted at Aguascalientes.

Production in 1924 in the other mineral districts of Mexico, such as Guerrero, Oaxaca, Queretaro, and Sinaloa, was relatively small. The outlook for 1925 is fair. The presidential elections have taken place, and the new president has been installed. It is the general belief that the policies of General Obregon will be continued and advanced by President Calles, and the hope is universally expressed that law and order will be maintained, so that industry, mining, and agriculture may thrive.

Central America

By Charles Butters and R. S. Botsford
Mining Engineers, 5 Nassau St., New York

The rise in the price of silver made mining more interesting in the Central American republics during 1924. Excepting the disturbances in Honduras, the political situation has been stable. The overwhelming majorities in the recent elections in Nicaragua point to four years of stable government there. The supply of mining labor in the five republics is dependent upon agriculture. The abnormal and persistent rain throughout Central America has, as a result, influenced the industries adversely.

The following summarizes the more important mining developments which we observed on our annual visit to Central America:

Guatemala — The New York Engineering Co. started up a new 8-ft. bucket-elevator dredge in October, 1924, 35 miles by rail from Puerto Barrios. The cost of the complete installation was $400,000. The dredge is of the all-steel type and electrically operated. The 500-kw. hydro-electric power plant supplies power for the dredge and markets the surplus power locally. The first few days' clean-up amounted to $7,000. A. C. Ludlum, of the New York Engineering Co., expects, as a result of initial dredging operations, a 4c. per yard working cost on the 10,000,000 cu.yd. already prospected. This yardage averages 20c. per cubic yard. Development has been carried on at the Alotopeque zinc-silver mines and likewise at the chrome ore mine of the International Railways of Central America.

Honduras—The New York & Honduras Rosario Mining Co. at San Juancito is continuing to expand its operations. A. R. Gordon, general manager, has made important reductions in operating costs and has increased the capital reserve over that prevailing during the previous year.

Nicaragua—The Chontales gold mine is milling at the rate of 5,000 tons of ore per month, and the Grecia silver mine, controlled by Butters Salvador mines, mills 1,000 tons per month. D. J. Pullinger's records show that Chontales has produced $3,500,000 since 1918 and the Butters-Salvador $1,500,000 since 1917. An adequate rate of development has been maintained at both properties. Satisfactory development work has been progressing at the Butters San Albino gold mine in the north.

Salvador—Mining for the last few years has been practically dormant, but an attempt is being made to revive it by the Central American Mines, Inc., at its properties in the neighborhood of San Miguel. Prospecting work has also been done at the San Sebastian mine, a property of the Butters Salvador mines. The government of Salvador has granted a concession of twenty-five years to stimulate mining in the republic.

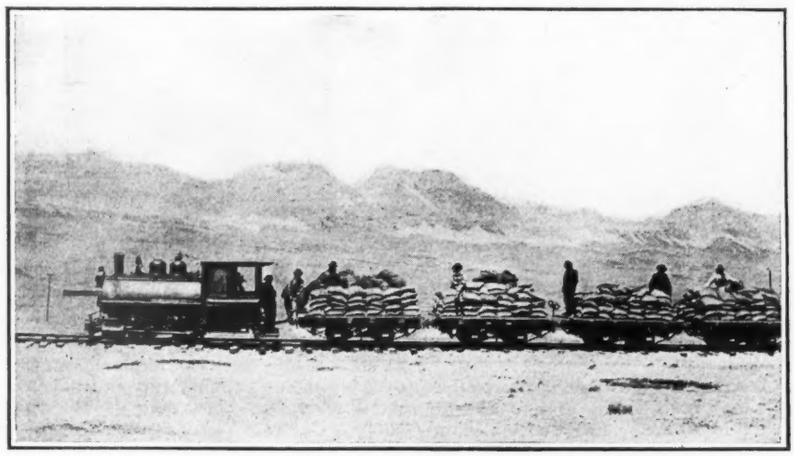
Costa Rica—Henry B. Price, of the Abangarez Gold Fields of Costa Rica, states that his company has operated its sixty-stamp mill throughout the year. Sinclair & Gordon have continued development at their Sacre Familia and El Libano properties. The erection of a ten-stamp mill with an accessory cyanide plant is under way at each property. Mina La Union carried on small-scale operations throughout 1924, the principal attention being given to development. The Aguacate mines also operated on a very small scale.

South America

Mining Industry Enters Upon Prosperous Era

Editorial Summary

MINING in South America was more active in 1924 than in 1923. Nitrate production for the first ten months was 1,943,976 tons, compared to 1,903,527 tons, the total for 1923. South America's most important mining industry was therefore prosperous. Copper production totaled about 453,000,000 lb., an increase over the previous year. Tin production is expected to be about 34,000 tons in 1924, or greater than in 1923, when it reached 29,774 long tons. Platinum production will be around 45,000, oz. and gold production should show an increase over 1923, which was 733,142 oz. Silver production will show a small decrease over 1923, due to restricted smelting activities at Cerro de Pasco during the last half of the year. The 1923 production was 27,335,073 oz. Petroleum production was about 22,000,000 bbl., an increase over that of 1923, when it reached 16,938,000 bbl. Bauxite production will be about 200,000 tons.



Hauling sacked vanadium ore from Mina Ragra, Peru, on railroad of Vanadium Corporation of America

Iron ore imported to the United States from Chile is estimated at 1,015,260 tons for 1924. Manganese ore exported from Brazil to the United States was 54,800 tons, against 88,036 tons in 1923, but no information is available upon the year's output of manganese ore. Vanadium ore, tungsten concentrates, bismuth, antimony, and lead and zinc ores were produced as in former years.

Chile — The important event of 1924 in the nitrate industry was the purchase of nitrate lands by the Guggenheim Bros., of New York, from the Chilean Government, on Sept. 15, 1924. Much interest was shown in the government auction, at which thirteen lots were sold for $6,750,000. The Guggenheim interests purchased four, known as the Coya Norte property, the price paid being $3,204,000. The process to be used in the new nitrate treatment plant which is under erection involves leaching at atmospheric temperatures and crystallization of the effluent solution by refrigeration. It is in its experimental stages. Apart from the increased exports and the greater prosperity of the industry no changes of importance in methods are to be noted. The Chile Copper Co. made a record production by increasing its ore tonnage. Late in 1924, announcement was made that the Andes Copper Co., also owned by Anaconda, had sold $40,000,000 worth of debentures, and plans are now being perfected to utilize this money in the completion of mining development, construction of a metallurgical plant, purchase of railway equipment, and to provide working capital.

Braden has had a successful year and made a slightly higher production in 1924 than in 1923. Costs have been lowered, but no changes in plant or methods of more than nominal importance were made. The Bethlehem Chile Iron Mines Co. operated its Tofo iron mine in 1924 and ore shipments estimated to amount to 1,015,260 tons were made to the United States. This was about double the 1923 shipment.

Bolivia—Activity in tin mining featured 1924. The Caracoles Tin Co. of Bolivia, a subsidiary of Guggenheim Bros., started its 200-ton concentrating mill in July. The tin concentrates are shipped to England and Germany. The Salvador has been started up, and its mill is now in operation. The interesting event of the year was the consolidation of strong companies represented by the Patiño and other properties. The National Lead Co. acquired an interest with Patiño about two years ago by the investment of $1,500,000. Patiño, who has been the owner of the Uncia Mine and the Machacamarca & Uncia railroad and had an interest in the Llallagua mine, desired to form a merger of his properties and the Llallagua to forestall legal difficulties and to secure greater economy in operation. The investment made by the National Lead Co. enabled him to acquire control of the neighboring mine. The new company is known as the Patiño Mines and Enterprises Consolidated and is incorporated in the United States at a capitalization of $50,000,000. Both Patiño and the National Lead Co. own an interest in the Williams-Harvey Corporation, which operates tin-smelting plants in the United States and Great Britain. Thus three strong factors—production, smelting, and manufacturing—are brought into close association.

The Oploca property is being steadily operated. The Araca company is also flourishing. Aramayo produced about 2,500 tons of tin concentrates in 1924 and Berenguela about 500 tons. The Berenguela property is reported to have been optioned. Cia. Minera de Potosi and San Jose de Oururo are operating steadily and producing both tin and silver.

Developments of transportation facilities and hydro-electric power and research in metallurgy are important factors in the future progress of the Bolivian mining industry. Cia. Huanchaca de Bolivia, after exhaustive laboratory experiments supplemented by pilot mill tests, found that blast roasting and acid-brine leaching gave much more satisfactory results on silver ores than flotation, both with respect to recovery and operating profits. In view of the isolation of Bolivia and the heavy freight charges, the solution of the metallurgical problems is dependant upon producing metal products rather than concentrates or other intermediate products. Apparently the Bolivia export duty on tin has not proved more than ordinarily burdensome, and other mining taxes are accepted, but, no doubt, some of the taxation laws will be amended.

Peru—In the Cerro de Pasco district the Cerro de Pasco Copper Corporation produced in 1924 about 30 per cent less copper and silver than in 1923, as a government decree resulted in curtailment of smelting operations since July 1, 1924. The difficulty arose from smelter fume and is being remedied by the installation of additional Cottrell treater equipment. One reverberatory furnace is in operation. A new central shaft is projected. A liquid oxygen plant of about twenty-five liters' capacity has been constructed. At Morococha ore mining was curtailed, but development work was continued at the usual rate. A new pilot mill to treat ore in the San Pablo section by concentration and flotation has been started.

Lake Punrun, in the Andes of Peru; elevation 14,200 *ft.*

No curtailment resulted at Casapalca, as the ore mined is silver bearing. Coal-mining operations at Goyllarisquisga were greatly reduced, due to the use, by the smelter, of fuel oil derived from wells in Peru. The Colguijirca property shipped ore to the Oroyo smelter and to the Cerro de Pasco mill.

Compagnie Minière de Huaron, because of drainage difficulties, operated in a desultory fashion. The Vinchos district, 25 miles from Goyllarisquisga, produced more or less silver ore, which was shipped to Europe.

In the Department of La Libertad, the Northern Peru Mining & Smelting Co., a subsidiary of the American Smelting & Refining Co., extended its operations and made a steady production. At the company's Diana mines, in the Milluachaqui district, a 7-mile wire-rope tramway was constructed by the Riblet Tramway Co., connecting the mine with the new mill which was completed during the year. Concentration by tables and flotation, supplemented by cyanidation, is the ore treatment plan. The mill has a capacity of 100 tons per day and the tramway 12 tons per hour. The mill has been operating successfully since its erection. The company acquired in the same district the Boza Aizcorbe Hermanos properties, consisting of the La Guardia mine, which adjoins the Diana mine, and certain other claims. A 100-ton mill unit, adjoining the Diana mill, has been practically completed and will be used for the treatment of the La Guardia ore. In the Quiruvilca district, the company has exercised its options upon the Quiruvilca mine and adjoining properties, and construction has been started upon a smelter which will produce 1,500,000 lb. of blister copper, together with gold and silver, per month. Pyritic smelting will be practiced and anthracite coal will be used for fuel. A wire-rope tramway, 20 miles in length, will connect the smelter with the upper terminal of the tramway connecting Milluachaqui with the Diana mill. A four-mile wire-rope tramway also constructed by the Riblet Tramway Co., will connect the coal mine with the Quiruvilca mine shaft, and the mine shaft will be connected to the smelter bins by a third wire-rope tramway with a capacity of 30 tons per hour. The plant will be known as the Shorey smelter. The company operates in the valley of the Moche River, which extends about 75 miles inland from the port of Salaverry, Peru.

The Vanadium Corporation of America operated its deposit at Mina Ragra, Peru, maintaining for the greater part of 1924 a shipping rate of about 500 tons of vanadium ore per month to its Bridgeville plant near Pittsburgh, Pa. A 28-mile narrow-gage railroad from Ricran, on the Cerro de Pasco railroad, was completed and placed in service on May 3, 1924. Transportation has been always a limitation on production at this mine, and the completion of the railroad enhances the company's facilities. A conservative production policy is followed, and provision is made in current production for the accumulation of a fair-sized stock at Bridgeville.

Colombia—The South American Gold & Platinum Co. had its dredges in continuous operation the greater part of 1924. Because of low water that interfered with the fuel-oil deliveries, several shutdowns occurred. The new hydro-electric plant was completed, and electric power is now being supplied to the dredges. During 1923, the company recovered approximately 12,700 oz. of platinum and 7,760 oz. of gold, valued at $1,364,000. For the first nine months of 1924, the recovery was 14,075 oz. of platinum and 6,800 oz. of gold, valued at $1,475,000. Improved operating conditions will result from the availability of hydro-electric power. The British Platinum & Gold Corporation, Ltd., operated one dredge the greater part of 1924, and a second dredge in the latter part of the year. Oroville Dredging Co., Ltd., operated its Pato and Nechi dredges throughout the year, with good recoveries for both dredges.

The Frontino & Bolivia Gold Mining Co. acquired a half interest in the Marmajito Mines, Ltd., owning adjacent properties in the Province of Antioquia. For the year ended June 30, 1924, the

company reports 24,920 tons treated, yielding 23,031 oz. gold and 16,120 oz. silver and a profit of $74,000.

Brazil—In gold mining Brazil produces annually about $2,500,000 from two gold mines, the St. John Del Rey and the Ouro Preto as well as other production from placers. The gold production of Brazil in 1923 was $2,990,697. Ouro Preto treats about 7,200 tons and St. John Del Rey about 15,000 tons of ore per month. More or less arsenic is produced as a byproduct. The year was normal. Manganese ore exports to the United States fell off still further.

Guianas—Gold production has probably diminished, although still important. Diamond mining in British Guiana continues to improve. The Demerara Bauxite Co. shipped in 1923, 103,346 tons of bauxite from its deposits near Demerara and a larger tonnage was expected to be produced in 1924.

Ecuador—Mining conditions have not greatly changed and there is little of interest to record. The production of gold by the South American Development Co. from its gold mine in the Zaruma district was about the same as in 1923. The production of the Zaruma district in 1924 was about $1,000,000, principally gold with a small amount of silver.

Petroleum—Venezuela leads in crude-oil production, the estimated outturn for 1924 being around 8,300,000 bbl. Practically all of this was from the oil fields about Lake Maracaibo. In 1925, Venezuela will greatly increase its production, probably reaching 20,000,000 bbl. This will depend upon prevailing prices and the receptivity of the United States to this importation. Argentina produced 3,399,651 bbl. of crude in 1923, and may increase this outturn to some extent in 1924. The product finds a local market which is only partly satisfied. The Bethlehem Steel Corporation announced, late in 1924, that it had signed a contract with the Argentine Republic for the erection of a modern oil refinery of 14,000 bbl. per day capacity at La Plata, Argentina. Trinidad produces around 3,000,000 bbl. of crude per annum as well as crude asphalt. Development of oil districts is at a conservative rate. In Colombia oil exports are not expected in 1925, and the small production that is now being made is locally refined and marketed on the Magdalena River. Plans are in preparation for the construction of a pipe line to seaboard. Standard Oil has a Bolivian concession and has brought in a few small wells. The Peruvian oil area in the northwestern corner of Peru is of considerable potential importance and yielded over six million barrels of crude in 1923.

Nitrate—The properties of the Anglo-Chilian Nitrate & Ry. Co. were acquired, late in December, by the Anglo-Chilean Consolidated Nitrate Corporation, a subsidiary of Guggenheim Bros., for, it is stated, £3,000,000 in 7 per cent bonds. The last-named company will also control the nitrate lands purchased by Guggenheim Bros. from the Chilean Government in September. E. A. Cappelen Smith is president of the new company.

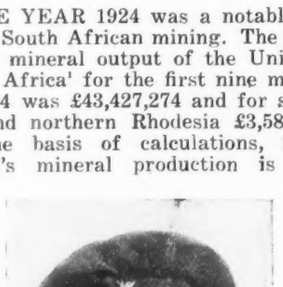
South Africa and Rhodesia

Improvement in 1924 to Continue in 1925

By Owen Letcher

Member, Institution of Mining & Metallurgy; American Institute of Mining and Metallurgical Engineers; Johannesburg, S. A.

THE YEAR 1924 was a notable one in South African mining. The value of the mineral output of the Union of South Africa[1] for the first nine months of 1924 was £43,427,274 and for southern and northern Rhodesia £3,583,353. On the basis of calculations, South Africa's mineral production is estimated to have been worth £62,500,000 in 1924, or 35 per cent more than the output for 1923.



Owen Letcher

The Rand Sets the Pace

The greatest expansion of output and the most marked improvement in profitable operation occurred in the Witwatersrand gold-mining industry, which it is estimated will make a record output of nine and a third million ounces of gold, worth approximately £42,000,000, or about 60 per cent of the world's output, compared with a production valued at £39,061,604 in 1923. The tonnage milled increased from 2,200,000 tons per month in 1923 to 2,400,000 tons per month in 1924, and the estimated gross profits for September, 1924, were £1,223,000, compared with £1,065,000 in September, 1923.

The outstanding feature of operations on the Witwatersrand gold fields during the last three years has been the substantial reduction of working costs. In December, 1921, just prior to the great strike of European miners on the Transvaal, the average working cost per ton milled was 24s. 11d., which was reduced to 20s. in 1923 and, in September, 1924, to 19s. 5d.

Numerous mines which were either making losses, or else were earning wholly inadequate profits in 1921, and which, with the substantial decline that has taken place in the price of gold since then, would long ago have been forced to close down, have been enabled to continue operations. The higher-grade mines have at the same time greatly increased their profits. Government Areas, which today must be accounted the leading gold mine of the world, has advanced its income from an average of £291,000 per month in 1921 to £336,000 in September, 1924, and its monthly profit has increased from £145,000 to £200,000.

Simultaneously, there has been a tremendous addition to the ore reserves of many mines by the automatic transfer of millions of tons of ore which was unpayable with the costs ruling at the 1921 level, but are now of importance with costs at their present level. This has encouraged the controllers of the mines to engage in new development, to sink new shafts, extend existing plants, and proceed with the installation of new equipment. Thus, toward the close of 1924, a new bid for the opening up of the Geduld East area was tendered by the Union Corporation to the government.

The Rand has, during the last year or two, witnessed a period of expansion such as has never before, perhaps in its whole history, been observed, and the effect of this on the country has been beneficial. The substantial reduction in working costs prevailing on the Main Reef series has been achieved principally as the result of better efficiency, resulting from the restoration of managerial authority after the collapse of the great strike; from improvements in the use of mechanical appliances, particularly light stoping drills, or jackhammers, underground, and the installation and use of improved surface plant and metallurgical appliances.

Underground Improvements Most Important

The most important improvements have been underground. Machine shift efficiencies have been increased to an almost unbelievable extent as a result of close investigation of drilling methods, qualities of material employed, the most effective use of explosives, and the employment of the latest and most efficient type of hand-held drills. The use of small, light drills of this type has proved the salvation of numerous low-grade properties on the Witwatersrand, especially in the Central, Western, and Near East sections. Hand-held drills have recently been put into operation on a very extensive scale on the Far East Rand, where the reefs are much flatter than in the other areas, and the latest results are exceptionally good.

The outstanding metallurgical features of 1924 were the successful operation of the new all-sliming plants at New State Areas and West Springs, the fairly general adoption of "corduroy" concentration along the Rand, and, at the end of 1924, the publication of details of the Modder East plant, which represent a still further advance in the latest Rand metallurgical prac-

[1]Figures for South West African Protectorate unavailable at time of writing, and therefor not included.

tice. The Modder East plant is designed for making a "one-pulp" product by means of two-stage crushing and tube milling. The nominal capacity will be 50,000 tons per month. Certain notable features are being introduced into the design, based largely on recent experience, which aim at increasing the all-round working efficiency of the plant. These are the utilization of a large-size jaw breaker to crush the mine ore; the efficient washing of the ore, and proper facilities for handling the washings by the introduction of a Dorr classifier and thickener, and the automatic sorting of tube-mill pebbles after the system suggested by the experience gained at the New Modderfontein mine. The secondary crushing plant will consist of Hum-mer screens and disk crushers. Standard 22 ft. by 5 ft. 6 in. tube mills converted to ball mills and synchronizing in their operation with the main tube-mill plant will be used for recrushing the reject pebbles. Agitators of the Brown type will be substituted for the usual large-diameter mechanically agitated tank used for the storage of the feed pulp to the Butters filter.

In the Modder East plant no attempt has been made to recover the valuable osmiridium content of the Far East Rand ores from an all-slimed pulp. The results obtained at Modderfontein East will, therefore, be of considerable interest.

Platinum Finds in the Transvaal

Apart from gold mining, the most interesting mineral development of 1924 in the Transvaal was the exploitation of the platiniferous deposits. Development of the lodes discovered in the Waterberg district in the early part of 1923 was continued throughout 1924 with encouraging results, and within the last few weeks important discoveries of platiniferous alluvials said to resemble closely the platinum alluvial deposits of the Urals have been made in the Lydenburg district, northeastern Transvaal. The companies principally interested in these latest discoveries are the Transvaal Consolidated Lands and the Transvaal Estates & Development Co.

In southern Rhodesia the new government has done its utmost to encourage the development of mining by subsidizing prospectors, and it has recently offered a reward of £5,000 for the discovery of a large and payable alluvial gold-bearing area.

The most important features of 1924 have been the excellent development in the Cam & Motor mine, at Gatooma, and in the Shamva mine, in the Salisbury district. Rhodesia's latest gold enterprise, the Sherwood Starr, is operating on a ten-stamp basis and yielding satisfactory profits. The outlook for continuance of values in depth is good. A prospect known as the "Turk," in which two or three influential Rand and Rhodesian companies are interested, is opening up well. On the other hand, development at one or two of the older mines, such as the Globe & Phoenix, the Lonely, and the Falcon, has not been showing such good results as were formerly secured.

The asbestos-mining industry has regained much of the prosperity which it enjoyed up until 1921, and the output for the first three quarters of the year has varied between 1,723 and 2,664 tons per month.

Sales of chrome iron ore for 1924, principally from the Selukwe area, averaged nearly 14,000 tons per month, compared with 8,000 tons per month in the preceding year. Coal and coke production from the Wankie colliery, in Matabeleland, was greatly increased during the latter months of 1924, largely on account of the increased copper production by the Union Miniere. In northern Rhodesia mining activity is marked, and, according to the opinions of mining men, the mineral output of the region between the Zambesi and the Congo will, during the next few years, exceed that of southern Rhodesia.

The hydro-electric plant of the Rhodesia Broken Hill Co. (zinc and lead) is being transported to the Mulungushi site. The Bwana M'Kubwa copper mine, on the Congo border, is being equipped with a new type of plant of 1,000 tons per day capacity, and numerous important copper-ore discoveries have been made in the area, which is being prospected under Preston K. Horner's direction in the Rhodesia-Congo Border Concession.

Altogether, 1924 was a satisfactory year from the point of view of the mineral industry in South Africa, and the outlook for a maintenance of production during 1925 is considered to be good.

Belgian Congo

Increased Copper and Diamond Production

By Sydney H. Ball
Rogers, Mayer and Ball, 42 Broadway, New York

THE Belgian Congo produced in 1924 about 85,000 metric tons of copper; 675,000 carats of diamonds (including Angola production); gold valued at more than $2,300,000; at least two-thirds of the world's uranium-radium ore, and about 1,500 tons of high-grade tin concentrates. The Belgian Congo is now the premier mining colony in the world, and ranks first in the production of uranium-radium, second in diamonds, and third in copper. The production estimates are based upon the first seven to ten months' production of 1924. In 1923, more than 250,000,000 francs was invested by the Belgians in their colonial possessions, indicating their confidence in the colony's future.

Colonial freight last year outgrew the capacity of the Lower Congo R.R., and, in consequence, needed equipment of certain mines was delayed at the coast. Betterments to this railroad, however, are being made. An all-Belgian route connecting the Katanga copper belt and the Atlantic port of Matadi is under construction. Surveys are being made for railroads to the gold fields in the northeastern Belgian Congo, and a railroad is being constructed in the French Congo, which will relieve the Congo freight congestion and also connect the Mindouli copper mines with the ocean. Many miles of motor road have been constructed. Preparations are being perfected for an airplane service between the Katanga copper mines and the Atlantic railhead.

Indicative of the difference in mining in Central Africa and the United States is the fact that the Forminière and its subsidiaries run a steamer up-country about 500 miles to their mines, and in addition to a narrow-gage railroad, have 1,100 miles of automobile roads. A number of square miles is also cultivated to supply food products for their black employees, and the company owns a herd of more than 10,000 cattle. Approximately 175 whites and 23,000 blacks are employed.

The Union Minière du Haut Katanga produced in 1924 about 85,000 metric tons of copper, compared to 57,856 tons in 1923, an increase of 48 per cent. During part of the year, the company was the largest copper producer in the world, and, in consequence, its important operations are becoming better known to engineers. Mining is done either by steam shovel in open pits or by overhand stoping from tunnels. The mines operated are the Kambove, Likasi, Star, Luushia, and Ruashi. Kalabi will begin production as soon as it is reached by the railroad. Fluxes, both iron ore and limestone, are obtained locally. On Dec. 31, 1923, the reserves amounted to 72,666,000 tons, averaging 6.2 per cent copper, or a total of 4,802,000 tons of metal. The staff consists of approximately 950 whites, and 13,000 blacks are employed.

In 1924, production was obtained largely by direct blast furnace smelting of high-grade ore and rich concentrates from the Panda mill. The pilot leaching plant at Panda produced a considerable quantity of electrolytic copper and additional ore was directly smelted in the experimental reverberatory furnace. Both of these plants will be enlarged. Local sources of sulphuric acid in quantity have not as yet been found. A Mineral Separation flotation unit of 500 tons per day capacity was started on the mill tailings in November, 1924. The 1925 production will probably reach 100,000 metric tons. The black copper, containing from 97 to 99 per cent copper, is shipped principally to the port at Beira, although increasing quantities are going by way of Dar-es-Salaam. More than half of the copper is refined by the Nichols Copper Co. in the United States. The rest is sold in Great Britain

and on the Continent. The costs were about 11c. per lb. in 1923; 1924 costs were presumably between 9 and 10c. per lb. The Union Minière du Haut Katanga is assisting the Société Générale Métallurgique de Hoboken to finance various new plant units, including a tin smelter, now in operation, a plant to treat cobalt-nickel-iron alloy, and an electrolytic copper refinery. Certain Katanga copper ores contain a high cobalt content, and in May, 1924, three electric furnaces at Panda began smelting this ore. A copper-cobalt-iron alloy is produced which is shipped to Hoboken, Belgium.

Additional Radium Claims Taken

Several radium deposits are known in the Katanga, and one at Chinkolobwe is being worked. Recently the Union Minière has taken up as mining claims additional discoveries in the immediate vicinity. The ore occurs in dolomitic schist and consists of various radium minerals, several of which are new species, at least one of which was discovered in 1924. In 1923, 600 tons of ore was produced. The richer ore is sacked, packed in cases, and sent to the Oolen works of the Société Générale Métallurgique de Hoboken. The lower-grade ore is stockpiled for future treatment. The mine is inclosed by a high barbed-wire fence. The company has a practical monoply of the radium market, producing at least two-thirds of the world's consumption.

The Société Internationale Forestière et Minière du Congo, or Forminière and its associated companies, operating the Kasai basin diamond fields, produced more than 675,000 carats in 1924, compared to 511,000 carats in 1923, an increase of 33 per cent. The stones had a value of approximately $7,000,000. The Forminière itself produced 225,000 carats, compared with 239,000 carats in 1923. The Beceka increased its production to about 250,000 carats, the Kasai Mining Co. produced about 46,000 carats, and the Luebo company 21,000 carats. The Diamang company, operating in the southern extension of the field in Portuguese West Africa or Angola, produced approximately 135,000 carats. The company's production was 96,000 carats in 1923.

Operation of Gold Mines

In the northeastern part of the colony, the Regie des Mines de Kilo-Moto continued to operate the state gold mines at Kilo and Moto. In 1923, these mines produced 3,146.6 kilos (101,195 oz.) of gold. The Kilo group produced 1,875.3 kilos (60,310 oz.) and the Moto 1,271.3 kilos (40,885 oz.). Of the Kilo production, about 15 per cent was obtained from the vein mines and the remainder from placers. The production of the two groups for the first eight months of 1924 indicates that the production for 1924 will approximate 3,500 kilos (112,560 oz.), worth $2,250,000. The mines have been for a long time on a paying basis, and the profits have been particularly large since the war, owing to the fact that the costs are paid in Belgian francs and the gold is sold on a dollar basis. The gold is refined in London. The Kilo gravels contain from 3 to 4 gm. per cubic meter ($1.47 to $1.98 per cubic yard). Those of Moto have a content of one gram per cubic meter (49c. per cubic yard).

In 1923, at Kilo, 276 kilos of gold were won from 18,800 metric tons of quartz averaging 14.65 gm. per metric ton ($8.55 per short ton). The alluvial gold contains about 90 per cent gold and 10 per cent silver; vein gold, 80 per cent gold and 20 per cent silver. The Société Minière de l'Aruwimi-Ituri is working two small placers in the same region, Senguli and Yambenda, each of which produced in 1924 about 3 kilos of gold (95.5 oz.) per month. The same company is preparing to operate four other small gold placers. The Compagnie Minière des Grands Lacs is also preparing to open up the Lindi placer.

The tin production of the Union Minière du Haut Katanga approximated 707 tons of high-grade concentrates and the Géomines produced approximately 800 tons. The Union Minière cassiterite is smelted in Belgium. The Simkat Co. also mined a little alluvial tin. This indicates a production of about 1,500 tons of cassiterite for the colony during 1924. Rapid expansion in tin production is retarded by labor shortages.

In 1923 the Luena coal field, worked by the Charbonnages des la Luena, produced 57,000 tons of coal and in 1924 perhaps a somewhat larger quantity. It has developed approximately 7,000,000 tons of minable coal and has a screening plant and small electric power installation. The coal, which is of low grade, is principally sold to the Katanga railroad, although a little is taken by the Union Minière. Two small portland cement plants are also in the colony, one in the Lower Congo and the other in the Katanga. Each has an annual capacity at present of about 15,000 tons. The Compagnie Minière des Grands Lacs Africains (capital, 10,000,000 francs) was founded Dec. 1, 1923, and took over the mining rights of the Grand Lacs railroad. It has four prospecting columns in the field, particular attention being paid to a gold placer on the Upper Lindi River and to sapphire deposits southwest of Lake Kivu.

Australasia

Gold Quiescent—Silver, Lead and Zinc Brisk—Copper Depressed—Tin Holding Its Own

By Peter G. Tait
Melbourne Correspondent, *Mining Journal-Press*, 90 William St., Melbourne, Australia

FROM the statistical point of view gold mining in Australasia has been declining steadily since 1903, when the production reached its zenith. In 1922, the output was 755,000 oz.; in 1923, 706,000 oz. and 1924 will almost certainly show a further drop. The recent decline is partly due to the restriction in the treatment of copper-gold ores. Australia, as a gold producer, is not an exhausted field. Western Australia, with its famous Golden Mile, and Victoria, with its wonderful Bendigo mines, are prospective producers on a larger scale, and experts say that "there is more gold in the ground than has yet been taken out." Signs of renewed activity are not wanting. Frequent reports of new finds are constantly noted, but the economic situation does not encourage investors.

Diminished Gold Production

In New Zealand, the gold situation is similar. The older established mines, like the Waihi group, are either worked out or operating on lower-grade ores at greater depths. No new mines of outstanding importance are being developed. The future of the Waihi field depends on the results of boring now in progress on the lower levels of the Waihi and Waihi Grand Junction mines. There has been encouraging revival recently in the gold-dredging industry of the South Island of New Zealand, and it is hoped that the modern dredging plant will succeed where the old type of dredges failed to give sufficiently good results.

Copper Mining Limited to Two Producers

Copper mining is practically limited to two producers, Mount Lyell and Mount Morgan. It was stated recently that Mount Lyell could not produce copper profitably when the price fell below £63 per ton. During the financial year ended Sept. 30, 1924, the company's net profit was £171,000, and the average price of copper for the period was about £67. The company has introduced many economies in its treatment process, and moreover has a "mint" in the North Lyell mine. The old Mount Lyell mine is now worked only for fluxing ore, the copper content being very low. Another factor which helps Mount Lyell is its fertilizer and chemical works.

The Mount Morgan mine, although continuing to produce, is not making profits. The Queensland Government is practically subsidizing operations to the extent of £1,100 per week by rebates on railway freights. No work of any account is proceeding in the Cloncurry field, and the famous Wallaroo & Moonta is a thing of the past.

The blister copper from Mount Lyell and Mount Morgan, and miscellaneous copper ore, goes to the Electrolytic Refining & Smelting Co. at Port Kembla. This concern was started as a sub-

sidiary of the Mount Morgan Co. Another is the Metal Manufacturing, Ltd., the plant of which adjoins the E. R. & S. This company is engaged in the manufacture of copper sheets, rods, and other products and is also drawing copper wire and manufacturing paper-insulated, lead-covered cable, aluminum steel-cored conductors, and other forms of conduits. It is a profitable enterprise.

Silver, Lead and Zinc

Broken Hill still maintains its supreme position as the premier mining camp of Australia, and many years of work are ahead. Several minor changes have occurred. The British mine is now being worked by the North Co.; the Junction has been taken over by the Sulphide Corporation, owners of the Central, the fire in which is still a matter for concern, and the Block 10 mine has closed down. The Amalgamated Zinc, De Bavey's, has also closed down its treatment plant at the Barrier, as all the dumps which it purchased have been treated. This company is now considering the question of undertaking the establishment of a timber pulping and paper manufacturing plant in Tasmania. Taking the field as a whole, however, it has many years of life ahead, and, having been fortunate to strike a year of excellent prices for its products, even the high wages and short hours do not cause undue alarm.

The Broken Hill Associated Smelters at Port Pirie are dependent on Broken Hill for supplies. When the Sulphide Corporation closed its smelting works near Newcastle, the B. H. A. S. acquired an extensive customs business; but recently it has been rumored that in future outside ores will not be looked for, the supply from Broken Hill being sufficient for requirements. This has given an opportunity for the representatives of European ore buyers to enter the market and to purchase ores for their plants.

Broken Hill is not the only silver-lead field in Australia. There are several consistent producers such as the Magnet, North Mount Farrell and Round Hill, in Tasmania; the Yerranderie, in New South Wales, and various mines in Queensland. The Northampton field, in Western Australia, promises to be a larger producer.

One of the surprising features of silver-lead mining in Australia is the decadence of the Zeehan field, in Tasmania. The so-called second-grade ore of Zeehan is twice as rich as the Broken Hill run-of-mine ore, and nevertheless promising mines lie idle. Although mines like the Western and Montana carried on extensive operations down to a depth of 1,500 ft. and were said to be worked out when they stopped about twenty years ago, there is undoubtedly a future for Zeehan as a silver-lead producer. It is surprising that Broken Hill interests have not seen the possibilities. Perhaps the fact that the Electrolytic Zinc Co. is operating on the zinc sulphides of the Read-Rosebury belt may lead to the revival of silver-lead mining in the district.

The Electrolytic Zinc Co. at Risdon, Tasmania, is making a daily output of 130 tons of zinc. The zinc concentrates from Broken Hill are roasted at various plants for the recovery of the sulphuric acid, used principally in the manufacture of fertilizers, and the calcines are shipped to Risdon. The company has now installed its own fertilizer plant, which will meet the requirements of Tasmanian agriculturists and afford another profitable adjunct for the company. A Schmeidel acid plant has been installed at Risdon.

Mount Isa, out from Cloncurry, which was hailed as a second Broken Hill, cannot be said to be living up to that claim. It is too early yet to say what the future has in store, but those associated with the big company claim that the prospecting work done holds out hopes of a large tonnage of prospective ore.

Australia is not an important tin producer, but such mines as the Mount Bischoff, Briseis, and Pioneer (the two latter being alluvial), all in Tasmania, are still active, and the present price is encouraging. A large part of the tin produced in Australia is from small enterprises and co-operative parties in Tasmania, New South Wales, and Queensland. There are three tin smelters in Australia, one at Launceston and two in Sydney.

Petroleum Activities

No petroleum has yet been found in Tasmania. Oil shale occurs in plenty, but oil produced from this source is very limited. There has been some talk of reopening the Crepuki shale-oil plant, in New Zealand, which operated for a short time many years ago. Considerable money has been spent by the Commonwealth Government in prospecting for oil in Papua (a Commonwealth territory) and the adjoining mandated territory of New Guinea. Oil has been found, but not as yet in sufficient quantity to be commercially important. Broken Hill interests have taken up the Taranaki oil field, in New Zealand, which has produced a fair quantity of oil, and the prospects appear excellent. Geologists and oil-drilling experts ascribe various reasons for the stoppage of the flow of oil which caused the collapse of the old company, and whether these views are correct prospecting now under way will decide.

Steel and Iron

There is little to say about iron and steel, as the local producers have been hard hit by the low prices ruling abroad, and their plea for greater protection is receiving sympathetic consideration by the government and the tariff board. It is of interest to mention that two well-known British firms are now associated with Australian enterprises. Hadfields are interested in Hadfields (Australia), Ltd., and Vickers are becoming interested in the Commonwealth Steel Products, Ltd. Both concerns manufacture steel products.

Western Europe

By W. A. Doman

London Correspondent, *Mining Journal-Press*, 111 Queen Victoria St., London E. C. 4, England

Mining in western Europe during 1924 has apparently experienced a stimulus. In 1923 the Ruhr occupation reacted unfavorably upon the copper and lead mines of France. Now that conditions have changed, a general improvement has been reported.

As a result of the eclipse of the Metallgesellschaft of Frankfort, Pen-

W. A. Doman

arroya now occupies the most important position in Europe as far as lead production is concerned. Early in 1924 floods in the Puertollano district checked operations for a time, though the Penarroya concession suffered only from the infiltration of water from adjacent mines. Pena Copper Mines, the chairman recently stated, benefited in 1924 from the policy initiated in 1922. "Costs have reached a low level," said the chairman, "which, while we cannot hope materially to improve upon, we must strive our utmost to maintain." The company does not publish much interim information, but the extraction for the first eight months of 1924 totaled 70,000 tons of ore, of which 60,000 tons was shipped. The company is in a sounder financial and industrial position than for many years.

The Huelva Copper & Sulphur Mines, of Huelva, Spain, not only suffered from events in the Ruhr, but also from the fluctuations in the English and Spanish exchanges. During 1924 conditions improved. For the first six months exports of pyrites amounted to 120,000 tons, against 75,000 in the corresponding period of 1923. The Rio Tinto made larger deliveries of pyrites in 1924 than in 1923, and efforts are being made to reduce working costs still further. None of the companies operating on the Continent give out much information between annual meetings, and these reports are somewhat belated. The Tharsis Sulphur & Copper Co. plans to erect a mechanical installation for the handling of its ores into and out of stock at the shipping terminal of the railway. A much lower cost is expected to result from its operation. Though Tinto, Tharsis, and

Mason & Barry all suffered from the low price of copper in 1923, they will show better results in 1924 owing to the rise in metal prices. The Esperanza Copper & Sulphur Co. has developed ore reserves, in amount approximating eight years' supply.

The Dome Mining Corporation, formed to work alluvial gold concessions on the Orbigo River, in northern Spain, had not installed its dredge at the time that this report was written, but it was expected that the dredge would be in operation by the end of 1924.

The Northern Exploration Co. (Spitzbergen) has continued exploration work, and has raised further capital for the purpose, though nothing that can be regarded as success has yet been achieved.

Respecting British mining, interest has been principally in the Cornish tin industry. Satisfactory developments have taken place on East Pool & Agar, at South Crofty, and at Geevor. At the South Crofty three stringers were cut recently, and from the strike indicated it is believed and hoped that they will converge and form a solid lode. The East Pool is opening up what is virtually a new mine; at Dolcoath important results are expected from the working of the Roskear lodes.

Central and Eastern Europe

By W. A. Doman

The development of mining in Near Eastern countries during 1924 was handicapped by the general depression caused by the scarcity of capital. In Turkey and Rumania, the government's unfavorable attitude toward foreign enterprise was the main obstacle to further progress, as the national capital of these countries is far from sufficient to expand mining activity. So far as Turkey is concerned, the Chester Concession, which gave rise to hopes for rapid progress in the exploitation of the country's mineral resources, has been cancelled, and, though there are negotiations constantly with various foreign groups, nothing definite has been granted to any other group. In Rumania, oil production has practically reached its prewar level, and the evidences of the devastation of the oil fields brought about by the war have been completely eradicated. Yet the much-discussed mining law has discouraged foreign capital from extending its participation in oil enterprises as well as from acquiring interests in mines.

In Jugoslavia, much hope is attached to the construction of the Adriatic railway, which is to begin in 1925, as it will make the mineral resources of southern Serbia available for exploitation. In Albania, an oil concession has been granted to the Sinclair interests, and several foreign, principally Italian, groups have obtained other mining concessions, but no definite steps have been made up to now for the initiation of operations. The Bulgarian oil-shale districts are beginning to attract foreign interests, and it is believed that within the next few years their working will assume considerable importance. In Greece, the operation of existing mining enterprises was undisturbed by political troubles, but conditions were not sufficiently consolidated to justify the expansion of mining to an appreciable extent. Political complications were responsible for the lack of mining developments in the succession states of the Ottoman Empire, but the definite settlement of the Mosul question is expected to give rise to relatively rapid progress.

The Central European Mines, in Jugoslavia, has paid its first dividend of 10 per cent, and results of development work are stated to have been highly satisfactory, both with respect to quantity and value of ore developed. Extensions and additions to the equipment and plant are being carried out, and the manufacture of lead products is being undertaken. Regular and increasing dividends are expected.

A new Italian company has acquired, under a government concession, the zinc mines at Raibl, in Italy. The company has been in possession of the property for some months, and it is stated that operations are being carried on with success, fully realizing the anticipations held at the start of the enterprise. Large extensions, additions, and improvements to the plant and machinery are being made.

[In December, 1924, the fact was made known that W. A. Harriman & Co., of New York, was negotiating with the Soviets for a twenty-year concession covering the important manganese deposits of Tchiaturi, in the Caucasian region east of the Black Sea. Great Britain and Germany are rivals with the Harriman interests for the concession. The mines are worked by a number of companies, and supply English, French, and German steel plants as well as certain plants in the United States with part, or all, of their manganese ore requirements. They were nationalized by the Soviets. See editorial in *Mining Journal-Press*, Dec. 20, 1924, p. 961.—Editor].

Russia and Siberia

By W. A. Doman

Conditions affecting mining in Russia and Siberia during 1924 have not changed for the better, and so far as can be learned at least three-quarters of the mines formerly worked are now closed. The Soviet authorities, upon the statement of one of their own employees, have lost at least £1,000,000 in attempting to operate certain properties, and this takes no account of damage through flooding and the depreciation of unused plant. In the valley of the Lena are some of the richest gold mines in the world.

The Orsk Goldfields, as an example, are at a standstill. The company's claim resulting from the confiscation and destruction of its property and assets still remains unsatisfied. Until compensation is received or arranged for, the resumption of operations in Siberia is not practicable, and no accounts can be submitted to the shareholders. The Russo-Asiatic Corporation, with its numerous mines and vast mineral deposits, remains idle. Occasionally rumors have been in circulation to the effect that the Soviet authorities were about to conclude some favorable arrangement for the resumption of operations, but nothing has eventuated, and apparently the claim of Leslie Urquhart for £50,000,000 compensation is still being ignored.

Definite data concerning the state of mining during 1924 in Soviet Russia, including Siberia, are not yet available. Only provisional figures referring to mining and metallurgical industries—these are taken from the Moscow daily papers—are obtainable. The output of iron ore in the Urals for the financial year ended Sept. 30, 1924, was 428,525 tons, and in the south of Russia approximately 23,000,000 to 25,000,000 poods, or roughly 400,000 tons, the two regions being, up to the present, the principal sources of Russian iron-ore supplies. The total pig-iron production in Russia for the same period amounted to about 40,000,000 poods, or 650,000 tons: the open-hearth steel production to 60,600,000 poods or 1,000,000 tons, and the manufacture of rolled iron and steel to 41,700,000 poods, or 690,000 tons. The corresponding figures for the year 1913 are: 256,900,000 poods; 259,270,000 poods and 214,220,000 poods.

The copper ore output in the Urals, the only region where the copper industry was active, yielded during the period under review about 100,000 tons of ore. The production of copper in 1923-24 amounted to 389,000 poods, or 6,500 tons, as against 2,095,000 poods produced in 1913, the copper output of the Urals alone being 1,055,000 poods. Zinc and lead ores were mined during the same period only in the north of the Caucasus in the state-owned enterprise, "Cauzine," which made a total year's output of 451,000 poods, or 7,500 tons. The smelter of the enterprise produced during that period 33,000 poods, or 550 tons of zinc; 23,750 poods, or 400 tons, of lead, and 150,416 zolotnik, or about 22,000 oz., of silver.

The newcomer in Siberia is the Pri-Amur Syndicate, formed to work silver, lead, zinc, and iron ore and coal deposits. H. F. Marriott is technical adviser to the syndicate. The engineer whom he selected to examine the properties is now on his way home.

India

By W. A. Doman

Gold mining in India in 1924 was principally confined to the Kolar field, where the Mysore, Nundydroog, Ooregum, Champion Reef, and Balaghat are being worked. No sensational developments have taken place. There have been the usual alternations of good and poor zones, but generally developments in depth in all the mines have disclosed a much better grade of ore in the lower

levels, and fairly good widths have also ruled.

No difficulties have been experienced, either in mining or transportation, and no change has taken place in treatment, the simplified system introduced last year having proved effective. A number of rockbursts have occurred, principally at Champion Reef and Nundydroog. Despite increasing depth—the Mysore is down 6,200 ft.—the temperature remains about the same. All the companies have felt the effect of the fall in the gold premium, and strenuous efforts made to reduce expenses to counteract it have proved successful. It will not be easy, I understand, to get operating costs lower.

Since the discovery of the field in 1880 the mines have produced about £60,000,000 worth of gold. In 1882, the prospects were so poor, and assay values were so low, that John Taylor & Sons, who have controlled the Kolar fields, were advised to abandon the enterprise. Mysore gold shares at that date were selling for 9d. each. It was the bold policy that succeeded. The Hutti is now exhausted, and the Anantapur field is worked out. The North Anantapur is, however, testing a property about 35 miles to the north, known as the Gooty area, in Madras. Little exploration has so far been done, but it is sufficiently satisfactory to encourage continuance. The field was worked by the "ancients," and it has been generally found that where the old workings are most extensive best results have been obtained. At No. 2 shaft on the 200 level driving was extended to the north, with poor results. To the south, however, 115 ft. has been driven under old workings, and the average was 3½ ft. in width and 15 dwt. in value. No other gold discoveries of importance have been made.

Refinery Production of the Burma Corporation

	Lead, Tons	Silver, Ounces	Antimonial Lead, Tons	Copper Matte, Tons
March quarter	11,979	1,276,311	200	346
June quarter	12,233	1,288,400	.	774
Sept. quarter	12,743	1,316,000	200	900
October	4,500	465,000	.	315
Total ten months	41,455	4,345,711	400	2,335

Zinc Concentrates

	Tons	Silver Ounces, per Ton	Lead, per Cent	Zinc, per Cent
March quarter	4,006	11.68	7.93	46.03
June quarter	4,400	10.84	7.1	45.69
Sept. quarter	5,074	10.41	8.08	45.30
October	1,855	10.57	8.58	45.51
Total ten months	15,335			

An interesting enterprise is the Indian Copper Corporation, formerly the Cordoba Copper Co. This company owns the Mosaboni mine, in Chota Nagpur, and it has also acquired the Sidesbur copper area adjoining from the North Anantapur side. The latest figures give the ore reserves at 219,782 tons, averaging about 3½ per cent copper. A considerable tonnage assayed 4.5 per cent. Development is to continue until the total reserve reaches 300,000 tons, when presumably additional capital will be required to install a treatment plant. No difficulty is anticipated in treating the ore, and there is a bounty of about £15 per ton of metal produced.

During 1924 the output of the Burma Corporation was on an ascending scale. The refinery production is given in the accompanying table.

For the six-month period, April 1 to Sept. 30, 1924, India exported to Europe, 357,269 tons of manganese ore. The amount for the corresponding period in 1923 was 383,320 tons. The United Kingdom was the largest importer.

Japan, Korea and Manchuria

By Hironao Nishihara
Mining Geologist, Dairen, Manchuria

ALTHOUGH the gold mines on Idzu Peninsula, Japan, were not affected by the great earthquake at Tokio and Yokohama in September, 1923, and no material loss was suffered, the destruction of many mining company buildings and executive offices in Tokio by the fire greatly interfered later in their mining and metallurgical activities. Retrenchment in every line of business followed as a consequence of the earthquake.

Hironao Nishihara

Statistical data available to the end of August, 1924, indicate that the showings since January have been discouraging. Production of metals and minerals in Japan was as follows:

Gold, oz.	175,232
Silver, oz.	2,471,800
Copper, lb.	84,878,819
Iron, metric tons	42,292
Coal, metric tons	18,131,850
Petroleum, bbl.	1,000,575
Sulphur, metric tons	28,684

Compared with corresponding productions in 1923, a decrease of between 4 and 10 per cent in the gold, silver, iron, and petroleum is indicated.

In the midst of the hard times experienced by the mining industry of Japan, the only gold mine enjoying unusual prosperity and showing ever-increasing production was the Taio Gold Mine, on Kiushu Island, which was described in an article appearing in the *Mining Journal-Press* of Nov. 17, 1923, p. 848. Before the earthquake the Taio mine was next to the Kushikino mine in production, but since December, when the all-sliming method was installed, its monthly production increased more than 50 per cent, or 3,000 oz. of gold, compared to 2,600 oz., the monthly production of the Kushikino mine. In May the Taio made a record production of 5,000 oz., and since then has maintained its production of more than 3,000 oz. per month.

Early in 1924 high-grade gold quartz deposits in Hokkaido, where gold placer deposits are extensively worked, were actively explored by a mining company, but without results of importance. The Japanese fuel problem has been given more extended consideration than ever before, as the national coal and petroleum reserves are limited. In October, 1924, the Japanese Government took steps to raise the price of gold from 5.04 yen to 6.40 yen per momme (one ounce equals 7.5 momme). This action resulted in material assistance to the owners of gold mines and the custom smelters. No record of Chinese mining for 1924 is obtainable. It has been reported in Korea that several old gold mines have been lately reopened, owing to the recent increase of the gold price. In other respects mining is absolutely quiet.

Two developments in Manchuria are of importance. One is at the Fushun Coal Mines of the South Manchuria Ry. Co., where a new plant will soon be erected to extract oil from the oil shale which overlies the coal seam. The average content of the shale is about 7 per cent, and large reserves, conservatively estimated to be more than a billion tons to a depth of 500 ft., are available for working. The mining cost should be greatly reduced, as the stripping of the overburden of the coal bed can be done on a large scale. The second is the successful solution of the ore-treatment problem at the Anshan Iron Mines. The rich ore of 60 per cent grade has been practically mined out and experimental treatment of the ore containing 36 per cent iron has been under investigation for a long time. A successful method is reported to have been discovered at the mine research laboratory. The hematite is heated in the presence of a reducing gas and becomes magnetic. The ore, which is reduced in size to two inches in diameter, is placed in a furnace, and heated to between 500 and 700 deg. C. Carbon monoxide gas is turned into the retort for a given number of hours; then the contents are allowed to cool down to 100 deg. It was found that the primary heating made the ore brittle and permeable to such an extent as to facilitate contact with the reducing gas. By magnetic separation the reduced ore yielded a product containing 90 per cent of iron. The monthly capacity of the furnace in the future will be 100,000 tons.

CURRENT PROBLEMS

Taxation

Substantial Progress in Tax Reduction

By Henry B. Fernald
Loomis, Suffern & Fernald, Certified Public Accountants, New York

Henry B. Fernald

THE LAST YEAR has seen a material change in the attitude of federal and state authorities toward taxation. Secretary Mellon had stated in the latter part of 1923 that federal taxes could be reduced, and his recommendations for such reduction had received the support of the President. They were in accord with a growing sentiment that taxation should be reduced and they gave a definite plan for such reduction. This precipitated a demand which could not be ignored. Although Congress failed to adjust the higher surtaxes to a revenue-producing basis, it did grant a substantial relief. The attempt to tax corporations on undistributed surplus failed, not because of any affection for wealthy corporations, but because Congress was forced to recognize that such a tax would grievously burden the smaller corporations whose prosperity depended upon a careful husbanding of resources and a prudent creation of reserves.

The recent elections have only more clearly shown that the people of the country are not in a mood to support plans for government activities or taxation which will hamper or penalize the business and prosperity of the country. State governments have likewise sensed this feeling of the people and have not been disposed to increase taxation, although few have been ready to bring about definite decreases. Municipal and other local taxation has been less affected by the sentiment for tax reduction. This may be because most of their budgets or estimates had been made a year ago, before the sentiment had been so clearly expressed.

Reduction of local taxes will not be an easy matter. Municipal and county expenditures have rapidly expanded since the war, representing both increased taxation and a flood of bond issues. A town or county which has been currently expending far more than it has raised by taxation must now make drastic retrenchment if its current taxation is to carry its present expenditures as well as pay for interest and retirement of bonds previously issued. The proposal for a constitutional amendment to eliminate further issues of tax-exempt securities was defeated in Congress, showing clearly that the rural communities want no action taken which will interfere with their present freedom of borrowing.

Many feel that the only hope for reducing local taxation is by exercising state control, as by limitation of tax rates or by establishing state authority with a veto power over local budgets. It remains to be proven whether we must to this extent abandon local self-government or whether the same strong demand which resulted in reduction of federal taxation will also bring about the reduction in local taxes.

Meanwhile, a Congressional committee is investigating the federal tax administration. Perhaps before this is published, their report may be issued. It is to be hoped that it will be on sound, constructive lines rather than a mere criticism of past mistakes. Mistakes were inevitable when, in the war emergency, we passed from a relatively low income tax to the high surtax, excess profits tax, capital stock tax, estate tax, and others. From a Treasury organization entirely unprepared for the work, there has been developed an organization which has collected revenues beyond all our prior conceptions. Moreover, this has been done under revenue laws so technical and conditions so rapidly changing that Congress has been passing new laws faster than the courts could interpret the old. Nor is the situation improved by the fact that the tax examiners are not highly paid and usually do not continue long enough with the government to master the technicalities of the law, to say nothing of the technicalities of the businesses which they are examining. Mistakes have been made and will continue to be made, often in favor of the government; sometimes in favor of the taxpayer. The large taxpayer can afford to contest an improper assessment, but smaller taxpayers are almost at the mercy of the examining agents.

A Congressional report which merely points out that errors have been made will not be news to taxpayers. What they would like to see is some plan whereby their tax liability can be more promptly determined, with less difficulty, inconvenience, and expense, and where ready justice is more easily obtainable. There is a real demand for relief from the indirect, as well as the direct, tax burden. A step in this direction has been the creation of the new Federal Board of Tax Appeals, to which any taxpayer may appeal before an additional tax can be assessed against him.

A further attempt to improve procedure is the recent order which provides for conferences of taxpayers with agents in charge of the various local offices for the purpose of reaching an agreement before an agent's report is forwarded to Washington. It remains to be seen how effective this will be in practice.

The Revenue Act of 1924 makes some definite changes in the provisions applicable to mines. The basis for depletion is for the first time definitely identified with the basis for profit and loss in case of sale. In the case of reorganizations, this involves a mass of technicalities. Depletion based on discovery is limited to 50 per cent of the profits in any year. The dividend provi-

sions have been largely rewritten. The law continues the general principle that surplus accumulated or value of property existing at March 1, 1913, may be distributed free from tax after profits accumulated since March 1, 1913, have all been distributed. Definite recognition is given to distributions from depletion based on discovery values. Recognition is also given to distributions in liquidation where there is a retirement or reduction in the stock.

The President has stated that a further reduction was possible for 1925. It seems to depend largely on Congress how and when this may be made effective. In any event, every reduction in tax rates should simplify the determination and collection of the tax.

Mining Legislation

By Paul Wooton
Washington Correspondent *Mining Journal-Press*

Paul Wooton

ALTHOUGH the Senate and the House committees on mines and mining were inactive during 1924, the mining industry received its share of attention. The outstanding activity in Congress has been that of the Senate Commission of Gold and Silver Inquiry, which early in its life ingratiated itself with the nation's silver producers by espousing the further purchases of silver at $1 an ounce to cover certain allocations of silver for subsidiary coinage. Apparently, valid reasons why these allocations should be replaced by Pittman silver were advanced. Technical objections on the part of Treasury officials, backed by Administration influence, prevented a successful outcome, but the commission's interpretation of the Pittman Act is being kept alive.

Mandatory legislation directing the Secretary of the Treasury to complete the purchases of silver contemplated by the Pittman Act has been acted upon favorably by the Senate Committee on Banking and Currency. Whether or not further purchases of silver at $1 an ounce are made, the determined and persistent efforts of an official commission in behalf of the silver producers have had an encouraging influence on a much-neglected industry.

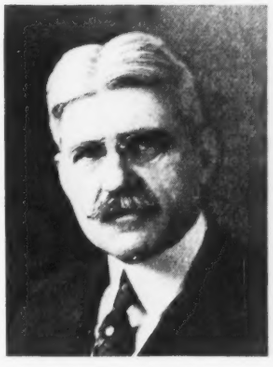
The Gold and Silver Commission has taken an active interest in various metal-mining activities. Its entire program has had as its objective permanent benefits rather than temporary relief for an industry that has suffered prolonged depression. However, the commission must fight for its existance, which, in the absence of new legislation, will end with the Fifty-eighth Congress on March 4, 1925.

The movement having for its object the creation of a federal department of mines has been held in abeyance pending the announcement of the Administration's general reorganization program. In the meantime, however, the Department of Mines bill introduced by Senator T. L. Oddie is being widely circulated, and the necessary public support is being aroused. One of the few mining bills to make legislative headway in 1924 was the measure proposing the appropriation of $500,000 for prospecting for and the encouragement of potash production within the United States. The amendment to the War Minerals Relief Act removing the provision which limited awards to a cumulative total of $8,500,000 is another interesting development. As amended, the law now permits the creation of a deficiency should it develop that additional funds will be required to insure equal treatment to all claimants.

Much of the legislation of interest to the mining industry which was acted upon by Congress during 1924 deals with research work and other activities which are handled by the executive departments, thereby bringing such legislation within the jurisdiction of the committees on appropriations instead of those of mines and mining. Consideration has been given in Congress to a program looking to the development of helium. Steps have been taken by the executive branch of the government which have resulted in the recovery of considerable amounts of helium and to the location of new supply sources. A large area of public land, known to contain helium-bearing gas, has been withdrawn as a helium reserve. The House Committee on Mines and Mining has given detailed attention to proposals for an enlarged program intended to insure greater safety in mining operations.

Railroad Transportation

By F. R. Raiff
Vice-president American Smelting & Refining Co., New York



F. R. Raiff

DURING 1924 the railroads have shown probably greater efficiency in their operations than in any previous year in their history. Less delay in freight movement, fewer congestions and embargoes, and more regularity in deliveries have resulted than in any previous similar period. This condition has proved to be of great benefit to manufacturers, to jobbers, and to consumers, as dependability in deliveries obviates the necessity of carrying on hand excessive supplies of goods and raw materials, and current requirements can be so regulated as to move to their destinations in quantities necessary for the daily or weekly needs. It has been reflected in the purchase of raw materials in smaller quantities than in the past, and has reduced the tie-up of funds and has permitted a quicker turnover, to the advantage of industry in general.

The improvement in railroad service is not confined to any one line or group of lines, but it is the prevailing condition on practically all of them. Competition in service and in the solicitation of traffic is keen. The

volume of traffic handled has been very heavy, and the high weekly loading records of the previous year have been broken frequently. As an example, the week of Oct. 18, 1924, showed a loading of 1,102,336 revenue cars, breaking all previous records. A significant fact is that, during that week, there was a daily surplus of 100,000 cars and a motive reserve of 5,400 serviceable locomotives. From Jan. 1, 1924, to Oct. 1, 1924, 120,727 new freight cars and 1,657 new locomotives were put in service, while during the last three years 454,654 new freight cars and 7,348 new locomotives have been bought, and, in addition, approximately 8,000 new passenger-train cars.

The establishment of Shippers' Advisory Boards, covering practically the entire country, has done much, in co-operation with the railroads through the Car Service Division of the American Railway Association, in bringing about a co-ordination in the supply, distribution, and release of equipment and a closer co-operation between shipper and carrier than ever before. These advisory boards are made up of shippers and receivers of freight.

There has been no notable readjustment of freight rates affecting the mining and smelting industry in general, although the carriers have been prompt in acting favorably on specific requests for the adjustment of individual rates when the necessity therefor has been clearly indicated, or when made necessary by the opening of new properties, or the diversion of either ores or products through new channels.

Ocean rates were maintained on a fairly constant basis throughout 1924, the principal ocean-shipping lines, through conference, maintaining uniform arrangements, but space has, at times, been available by lines not in the conference at rates somewhat lower than those prevailing on the regular or so-called "conference" lines.

With ocean rates fairly well stabilized; with railroad rates on a firm foundation and subject to such individual changes as may be approved by the Interstate Commerce Commission; and with the new railroad equipment now in service and that under orders to take care of any normal increase in industrial requirements, the railroad problem, so far as it has ever been a problem, seems fairly close to a solution—at least for the year 1925.

Labor and Wages

By Arthur B. Parsons
Assistant Editor, *Mining Journal-Press*

BOTH mine operator and mine worker have reason to be satisfied with the present labor situation—which is as it should be. Generally speaking, wages did not change materially during 1924 and the cost of living did not increase greatly. From the employers' standpoint the "labor market" is somewhat easier than it was a year ago; but on the other hand there is no abnormal unemployment in the mining communities.

About the only complaint comes from Michigan. The copper producers there talk of a labor shortage and see in it a serious problem when it becomes desirable to increase output. That is to be expected, however, especially in view of the fact that the long period of great curtailment has naturally made miners skeptical of the Copper Country. The accompanying table, however, shows a marked increase in the earnings of miners in Michigan, which, after all, is the most effective step toward building up working forces.

The significance of the last column in the table is this: The miner who is competent mentally and physically can earn more in a mine than he could in most other kinds of so-called unskilled work. If a superintendent has a fair proportion of first-class miners he can organize operations to include less useful men and attain reasonable efficiency. The results, generally, are better than if the day's pay scale is increased. Of course, reports come from various districts that more high-class machine men could find work; but that will always be true except in periods like that of 1921-22, during which the copper industry was nearly dead. The same rule holds in banks and farms and factories and offices; the demand for exceptionally competent men is never satisfied.

Most mining companies are continuing their efforts to provide every reasonable device to make mines safe and healthful. The growing use of machinery has decreased the number of men required to mine a given tonnage. These factors have helped the situation. Progressive companies are doing more and more to make attractive the isolated communities in which the workers must live and raise families, if they are to be more than transient employees.

Daily Wage Scale in Various Mining Districts

Each Scale Represents the Wages Paid by One or More Companies

State	District	Surface Laborers			Underground Miners			Bonus or Contract, 1924	
		Jan. 1, 1923	Jan. 1, 1924	Dec. 1, 1924	Jan. 1, 1923	Jan. 1, 1924	Dec. 1, 1924	Percent of Underground Men So Paid	Average Daily Earnings
California	Sutler Creek	$3.50	$3.50	$3.50	$4.50	$4.50	$4.50	..	..
	Randsburg	4.75	4.75	4.75	6.25	6.25	6.25	..	..
Nevada	Virginia City	4.75	4.75	4.75	5.25	5.25	5.25	..(a)	..
	Tonopah	5.00	5.00	5.00	5.75	5.75	5.75	..	..
Washington	Cornucopia	4.50	4.00	4.00	4.50	4.50	4.75	..	..
Montana	Butte	4.25	4.25	4.25	4.75	4.75	4.75	35	$6.50
Utah	Tintic	3.75	4.25	4.25	5.00	5.50	5.50	..	..
	Park City	4.50	4.50	4.50	5.12	5.12	5.12	..	..
Arizona	Oatman	4.50	5.00	5.00	5.00	5.50	5.50	..	..
	Miami	3.03	2.75	2.75	5.45	4.95	4.95	35	6.25
	Ray	2.81	2.81	2.81	4.73	4.73	4.73	13	5.25
Idaho	Lakeview	4.00	4.00	4.00	5.00	5.00	5.00	..	..
	Wallace	4.25	4.75	4.75	5.00	5.50	5.50	..(b)	..
Colorado	San Juan	3.75	4.00	4.00	4.75	4.75	4.75	60	8.00
	Cripple Creek	3.75	3.75	3.75	4.50	4.50	4.50	60	5.07
Oklahoma	Picher	3.50	3.50	3.75	4.00	4.00	4.50	15(c)	5.70
Michigan	Houghton	2.60	3.15	3.15	3.54	5.02	5.24	..(d)	..
	Painesdale	2.50	3.00	3.00	3.65	4.25	4.25	..	..
Tennessee	Mascot	2.25	2.50	2.50	3.06	3.45	3.45	25(e)	6.60
	Ducktown	2.72	2.96	2.96	3.52	3.76	3.76	30(e)	5.52
South Dakota	Lead	3.25	3.25	3.25	4.50	4.50	4.50	15	6.90
Ontario	Porcupine	4.24	4.24	4.24	4.80	4.80	4.80	8	5.50
	Sudbury	2.88	3.40	3.40	4.48	4.72	4.72	..	..
British Columbia	Anyox	3.60	3.60	3.60	4.75	4.75	4.75	75	6.50
	Stewart	4.25	4.25	4.25	5.50	5.50	5.50	75	6.50
Dun's Commodity Index (f)		....	....	....	185.63	189.93	197.99	..	..

(a) Bonus plan started Dec. 1, 1924. (b) Bonus based on price of lead is included in figures given. (c) Shovelers working on contract earned from $5.40 to $6 a day. (d) The figures given for miners include a bonus. (e) Includes machine men only. (f) Indicates roughly the comparative cost of living.

Foreign Trade in the Metals and Minerals

By Felix Edgar Wormser
Assistant Editor, *Mining Journal-Press*

HEAVY NET EXPORTS of copper and zinc characterized the foreign commerce of the United States in the non-ferrous metals during 1924. In part this accounts for the improvement that has occurred in the market for these metals and it also testifies to the improvement that has taken place in the political and industrial conditions in Europe.

The exports of zinc can only be regarded as unusual. Normally the United States is not a zinc-exporting country and relies upon a tariff to prevent importations. Few persons would have predicted that export business in zinc would attain the proportions it has in the last few months, a condition that is likely to continue well into 1925. The non-metallic minerals show little change in foreign commerce. Those which move into the United States regularly maintained the flow, especially china clay and asbestos. The complete record follows:

Movements of Ores and Metals To and From the United States (a)

In Pounds

(*a*) Bureau of Foreign and Domestic Commerce. The reports of the bureau are no longer classified according to the origin of imports or destination of exports and hence are not so comprehensive as in former years.

I—Copper

	1923	Ten Months Ended Oct., 1924
Imports		
Ore, concentrates, matte	143,077,840	117,679,556
Unrefined, black, blister	394,645,037	380,128,303
Refined	129,086,204	120,308,538
Old	9,902,006	2,790,562
Total	675,711,087	620,906,959
Exports		
Refined	729,380,207	822,598,064
Rods	62,693,305	52,091,166
Wire	9,842,992	8,638,659
Cable	11,681,450	13,399,875
Other forms	15,376,836	12,385,881
Total	828,974,790	913,514,433

II—Lead

Imports		
In ore and matte	66,882,850	82,368,444
In bullion	161,496,495	131,734,223
In pigs, bars and other forms	42,198,848	23,578,261
In manufactures	7,753,881	1,675,420
Total	278,332,074	239,356,348
Exports, in pigs and bars		
From domestic ore	4,110,185	9,331,286
From foreign ore	92,306,894	113,454,842
Total	96,417,079	122,786,128
Other manufactures	8,431,863	12,958,870

III—Zinc

Imports		
In ore	3,118,314	7,441,072
In blocks and pigs	42,930	39,449
In other forms	109,171	116,082
Exports		
In ore, concentrates, dross	29,489,615	17,153,378
Slabs, blocks and pigs		
From domestic ore	84,261,650	96,177,028
From foreign ore	14,148,806	
Total	98,410,456	
Sheets	7,463,362	6,110,554
Dust	7,357,049	3,887,583
Other manufactures	1,225,272	760,109

IV—Gold and Silver

	Gold	Silver
Imports		
1923	$290,074,586	$66,281,229
1924 (11 months)	309,434,074	68,080,410
Exports		
1923	27,931,888	62,947,706
1924 (11 months)	21,973,660	98,611,403

V—Exports of Minor Metals and Minerals

	1923	Ten Months Ended Oct., 1924
Aluminum, lb.		
Ingots, scrap	1,169,753	3,013,764
Manufactures	9,808,353	8,217,215
Quicksilver, lb	23,827	12,399
Nickel, metal and manufactures, lb	1,356,246	1,779,104
Platinum, oz	1,742	4,896
Tin, lb.		
Bars	1,679,803	805,167
Manufactures	8,970,743	5,876,814
Asphalt and bitumen, tons	64,846	40,532
Manufactures of, lb	60,969,483	63,347,112
Sand and gravel, tons	492,172	237,162
Cement, bbl	1,001,688	783,202
Fireclay, tons	44,692	33,008
Other clays	31,107	23,185
Asbestos, tons	607	932
Gypsum, lb	17,629,808	18,448,349
Mica and manufactures, lb	1,804,342	1,281,293
Sulphur, tons	472,525	412,749
Salt, lb	251,057,170	242,453,183
Graphite, lb.		
Unmanufactured	1,815,292	1,774,884
Manufactured	2,081,041	1,201,023
Phosphate, tons		
High-grade hard rock	194,339	128,860
Land pebble	630,565	549,204
Other rock	2,647	10,487
Borax, lb	40,498,964	28,232,881
Ocher, umber, sienna, whiting, etc., lb	28,584,484	23,631,506

VI—Imports of Minor Metals and Ores

Aluminum, lb	42,991,105	24,869,715
Antimony, lb.		
In ore	2,094,095	1,428,932
Metal	15,626,928	12,644,389
Cobalt, lb	284,358	125,549
Iridium, oz	1,611	1,218
Osmium and osmiridium, oz	2,636	1,182
Palladium, oz	14,578	8,714
Rhodium and ruthenium, oz	1,292	1,338
Nickel, lb.		
Ore and matte	14,601,820	8,524,717
Manufactures	26,253,921	17,680,489
Manganese ore, tons	206,048	216,716
Chrome ore, tons	88,570	100,436
Tin, lb.		
Bars, blocks, pigs	153,864,685	124,607,893
Manufactures	288,995	
Tungsten, lb		78,981
Vanadium ore, lb	4,177,116	(*b*)

(*b*) No classification.

VII—Imports of the Non-Metallic Minerals

Bauxite, tons	119,020	183,302
Marble, cu. ft	697,999	573,092
Sand and gravel, tons	426,573	500,960
Lime and limestone, lb	50,713,900	38,963,707
Kaolin, china and paper clay, tons	279,166	265,457
Other clays, tons	67,656	66,420
Corundum, tons	5,016	3,115
Emery, tons	6,344	5,795
Flint, tons	14,243	14,380
Asbestos, unmanufactured, tons	189,661	135,820
Asbestos, manufactured, lb	15,068,546	18,903,423
Cryolite, tons		4,140
Chalk, crude, tons	122,983	84,941
Fluorspar, tons		36,858
Gypsum, crude, tons	400,115	394,668
Mica, crude lb	1,017,712	538,009
Cut, split, lb	6,171,079	4,681,739
Monazite, tons		144
Diamonds, rough, carats	200,222	170,829
Cut, unset, carats	539,972	427,989
Pyrites, tons	259,926	203,784
Talc, lb	38,811,812	30,323,462
Magnesite, lb	172,069,989	136,494,303
Salt, 100-lb	1,968,791	1,802,010
Graphite, lb	39,633,575	28,421,458
Mineral wax, lb	5,000,597	2,560,906
Iodine, crude, lb	274,238	
Nitrates, crude, tons	2,747	2,137
Ochers and sienna, lb	21,022,483	16,496,735
Other pigments, lb	78,657,524	61,444,706
Potash, tons		
Crude chloride	135,497	99,340
Crude sulphate	63,578	50,153
Kainite	160,211	119,372

VIII—Iron Ore and Pig Iron

Exports		
Iron ore, tons	1,116,932	577,043
Pig iron, tons	32,318	37,456
Imports		
Iron ore, tons	2,768,430	1,641,801
Pig iron, tons	367,820	171,086

New Machinery

Improvements in Mine Hoists and Locomotives

By A. H. Hubbell
Managing Editor, *Mining Journal-Press*

A. H. Hubbell

DEVELOPMENT of new machinery used in mines, mills, and smelters and improvements in existing machines were more marked in some lines than in others during 1924, according to reports of manufacturers. As usual, a large number of models were put forward as new by machinery houses simply to complete their line or to widen the range of sizes and capacities available, or possibly the better to meet competition. Some new equipment of decided interest was introduced and in general considerable progress was made in meeting the demand for greater economy.

Drills—Effort to develop lighter rock drills that will do as good or better work than their heavier prototypes was apparently the only departure from standard practice in 1924. On the one hand, the lightest possible drill was sought for deep mine work, and on the other the largest and heaviest for big tunnel projects. Minor improvements were numerous. One maker devoted his attention to completing his independent rotation series, in which the chuck is given enough torque to keep the steel from sticking; the series included a 225-lb. machine for deep-hole prospect drilling; a 146-lb. sinker; a 65-lb. sinker which with a slight change and a mounting becomes a 125-lb. drifter; and a 99-lb. stoper. Hammer drills continued increasingly popular. A line of valveless drills, designed according to principles of construction of valve-operated tools and intended for the small operator, was further developed by a manufacturer who also introduced a machine for sharpening only ⅞-in. and 1-in hollow hexagon steel. Air-line oilers are said to have gained in favor for lubricating rock drills.

Diamond-drilling equipment introduced in 1924 included a gasoline-driven unit consisting of a drill, a gasoline motor, and a triplex pump, all of standard makes and sizes, mounted on a steel truck with either steel wheels or a caterpillar tread. Certain novel features as to the method of supporting and controlling the rods were embodied in another machine. A new churn drill of cast steel, designed for open-pit mines, will handle a one-ton string of tools consisting of a 5-in. x 20-ft. drill stem and a 400-lb. 8-in. bit.

Compressors—Essentials of compressor design remained unchanged throughout 1924. A new model of single-stage centrifugal machine, in both single- and double-inlet types, announced early in the year, has as its chief features strong construction, accessiblity, improved pressure characteristics, and higher efficiencies, the capacities ranging from 500 to 75,000 cu.ft. per minute at 0.75 to 6 lb. pressure. A straight-line two-stage compressor of low capacity (360 cu.ft. per minute) and at least two portable one-drill machines were introduced.

Haulage—Considerable advance was made in mine-haulage equipment in 1924. Standard designs of low-height mining locomotives were developed to meet many cases heretofore involving special construction. Up-to-date practice is typified in some d.c. locomotives constructed (30-in. gage, 25-ton, 600 volts) that are arranged for multiple unit operation, regenerative braking, and forced ventilation of motors. The range of size of storage-battery locomotives was increased, a 75-ton unit, the largest yet built, being developed, and, at the other extreme, another new model small enough to go on a mine cage was introduced. An interesting installation was that of a locomotive consisting of two 10-ton chassis units in tandem, each with two 60-hp. motors and a battery of eighty-eight cells. These units may be operated singly or in pairs from battery or trolley wire, with automatic charging of the battery when the pole is on the wire. Another tandem locomotive having two 9-ton units, 30-in. gage, 70 in. high by 60 in. wide, with a drawbar pull of 9,000 lb. at 6 miles per hour, is equipped with brakes, sanders, inclosed ventilated motors, controller, and couplers, the general arrangement being out of the ordinary for a mine locomotive. Demand for a locomotive that will pull heavy loads on a narrow-gage track at 15 to 20 miles per hour was met by a 13-ton trolley locomotive, 24-in. gage, having two 90-hp. motors. Two new lines of locomotives, storage battery and trolley respectively, have cross equalization as a salient feature, providing for three-point suspension. A 4-ton (also 15-ton) gasoline gear-driven four-speed locomotive with a drawbar pull of 3,000 lb. at lowest speed was introduced.

Pumps—For pumping from shallow depths centrifugal pumps continued the most popular. A low-head centrifugal pump, made in smaller sizes and having a number of mechanical improvements, introduced by an important maker, was the only development of note reported.

Fans and Blowers—There were no changes in 1924 in the general type of rotary positive pressure blowers for smelting furnaces and flotation plants. A rotary displacement type of meter for the accurate measurement of air or gases was further developed. Increased use of booster fans led to improvements in small blowers used in secondary mine ventilation; certain changes in design were made to increase their efficiency, utility, and adaptability to all mining conditions,

Hoists—Several notable installations were made in 1924. Two hoists, one for ore and the other for men and materials, were built for a Southwestern copper mine. The ore hoist is automatic, running without an engineer on the platform, the only attention required being a "loader" at the shaft bottom, who starts the

hoist by closing a small master switch when the skip is filled with ore. It hoists automatically from three different levels and is the largest equipment of this type in physical dimensions so far constructed. It is operated by a d.c. hoist motor rated at 2,150 hp., 51 r.p.m., 650 volts, direct-connected to the drums. It can raise 10,000 tons of ore in sixteen hours from the deepest level (1,485 ft.) at 12 tons per trip, and one trip every 69 seconds. The man and material hoist consists of a 600 hp. 400 r.p.m. 550-volt d.c. hoist motor geared to the hoist drum and a motor generator set consisting of a 450-kw., 750-r.p.m., 550-volt shunt-wound d.c. generator; a 500-hp., 750-r.p.m., 6,600-volt, 3-phase, 25-cycle slip-ring induction motor, and a steel plate flywheel weighing 16,500 lb. A master switch and contactors are used for controlling the generator field instead of a drum controller, permitting use of current limit control of acceleration and retardation.

A 1,200-hp., 2,200-volt mine hoist was installed using electro-pneumatic control. This is the first installation of this type and is expected to increase the use of large hoist induction motors.

The largest flywheel mine hoisting equipment ever installed was placed in operation at a coal mine. The hoist is driven by two 2,000-hp., 75-r.p.m., d.c. motors. The flywheel set consists of two 1,650-kw. 600-r.p.m. d.c. generators, one 50-kw. exciter, and one 2,200-hp., 2,200-volt motor and a 90,000-lb. flywheel.

To meet the demand for a portable hoist for use underground where compressed air is not available, but where electric wires are strung to the working place, a line of single-drum and double-drum electric portable hoists was introduced by one maker. In these the motor is entirely within the drum.

Scrapers and Loaders—Experimentation with various types of scrapers and car-loading slides was continued, privately, in 1924. One new "loader" was reported during the year to have been developed. This is a self-contained machine consisting of short and rather steep slide mounted on a movable truck, the scraper hoist being carried in front on a small platform over the slide with sufficient room for the scraper to pass beneath. The loading platform over the car is carried as a cantilever from the slide. At the rear end of the cantilever boom a sheave is mounted, over which the hoisting rope passes. Still another loading slide was reported to have been developed at a South American property; this is carried on a four-wheeled steel-frame truck, equipped with two vertical air cylinders by which the horizontal section of the slide may be raised sufficiently to permit a car to be run beneath. Minor improvements were made in underground loading machines,

Power Shovels—Mining companies are manifesting greater interest in electrically operated excavating machinery, just as manufacturers are moving to electrify their entire line. The electrical application has been greatly simplified and perfected. A recent development is the Diesel operated shovel and dragline, though not used yet to any extent by mines. A pronounced change in the motor-generator set in railroad type shovels was made, the manufacturer in this case standardizing on only one set (instead of two) consisting of a synchronous a.c. motor driving the hoist, swing and crowd generators, and mounted in the center of the shovel, thus affording more room. Crawler trucks remain the principal improvement made in the last two years, rendering the shovel more mobile, reducing costs, and saving time. Another change consisted in improving the hoist drive on an 8-yd. electric shovel, affording quieter running and direct and effective braking on the hoist motors.

Crushing and Grinding—Aside from the development of the design of a double-discharge ball mill in which the ore is introduced into two separate compartments having a common axis of rotation and which will have, it is claimed, a higher discharging efficiency than that afforded by the usual design, there were no changes in design or construction of ball mills in 1924. Rod mills, being a more recent product, underwent some changes, principally in the method of support. Instead of being carried on one trunnion, two rollers and a tire, each of the twenty big mills installed at Ajo is carried on two rolled-steel tires and four large rollers having rolled-steel shells. This construction saves power by reducing friction, and makes it possible to do away with the usual scoop or drum feeder, the ore being simply spouted in. Experiments were continued with a four-compartment rod mill and with some others of rather bizarre design.

Screens—The Bureau of Standards series of standards for testing sieves has been broadened to permit the use of regular standard market grades. During 1924 a screen cloth with a flat wearing surface insured by use of rods or wires having a short deep crimp which receives the entire depth of the crossing rods or wires in both directions was introduced. Two new types of grizzlies made their appearance, one of the ring type in which the bars, rings, and spacers have a slight spiral movement, the oversize traveling endwise to discharge. The other consists of a set of parallel stationary manganese-steel bars, bent concave, between which revolve steel arms keeping the grizzly clean. Two makes of new vibrating screens were introduced.

Tables—A new method of driving Wilfley tables by means of an electric motor was developed, involving the use of a worm drive completely inclosed and running in oil, all backlash being eliminated. Rubber riffles were given a careful trial, with promising results.

Metallurgical Equipment—Among several machines of metallurgical application that were pushed forward during 1924 the only one of particular interest was a new flotation unit provided with a novel method of insuring aëration by means of a rotating member of hard rubber. Only minor changes were reported in filters of various types. A comparatively new application of continuous vacuum filtration is the recovery of blast furnace dust.

Power—A feature of 1924 was the development of several well-designed types of Diesel engines in sizes suitable for mining purposes. The most important of these was a two-cycle double-acting Diesel, in which every stroke is a power stroke. For this is claimed a fuel economy comparable with that of the best types of Diesel engines, with dimensions, weight and construction costs per horsepower approaching those of steam machinery. Another maker introduced a vertical Diesel for marine and stationary service in ratings of 36 to 300 hp., the engine starting without the aid of auxiliary ignition devices. Still another interesting development was the application of the light-weight oil engine as a prime mover in the locomotive, resulting in the production of a 1,000-hp. Diesel electric locomotive.

MARKETING AND STATISTICS

Copper Market Firm

Record Production and Consumption in 1924

By Joseph Clendenin
Manager Sales Department, Guggenheim Brothers, New York

OPTIMISM PREVAILED throughout the copper industry at the close of 1924. The mines are selling their output currently as it is ready for the market. The consuming mills are working to capacity. The price is firm at 15c. delivered.

Looking back, the unjustified lack of confidence in copper on the part of both producers and consumers during the first nine months of the year was a distinguishing feature of copper in 1924. Consumption was greater than in any other peace year. Consumption in the first quarter was heavy here and abroad, the total takings for the three months in 1924 exceeding those of 1923 by nearly 70,000 tons. During the second and third quarters, when the iron and steel industry was depressed below 50 per cent of normal capacity, domestic fabricators took copper at the same rate as in the corresponding period in 1923 and, to help build up the record consumption, the exports during these two quarters were 78,000 tons greater than in the corresponding period of 1923. The last quarter has shown a steady expansion in consuming activity both here and abroad, this being especially marked in export volume, which averaged 53,000 tons monthly and made the exports of copper in 1924 the heaviest yet recorded.

Production throughout the year held fairly steady at the rate of 108,000 tons per month, or 11,000 tons monthly more than the 1923 average. In spite of this increased production, the stock of marketable copper, 155,885 tons on Jan. 1, 1924, decreased to 136,434 tons on Dec. 31, 1924.

The price in early January was 13c. There was such a lack of confidence in copper, coupled with an urgent and general desire on the part of producers to keep their metal sold, a condition continuing through September, that the price for the first nine months averaged only 13c. This selling policy was an exceedingly costly one, entirely unjustified by the supply and demand position, in that the market absorbed 139,214 tons more in the period than for the corresponding nine months of 1923. Contributing causes to the lack of confidence were the general feeling of pessimism here during the spring and summer months as to all commodities and the disastrous drive against the "franc," involving highly speculative trades in copper and other metals, which demoralized the market.

Beginning with October the whole situation changed with the clearing up of the European situation and the favorable results of British and American elections; confidence was restored; selling pressure was withdrawn; and in the last three months the price has advanced 2c. per lb. Great progress has been made in the restoration of financial and commercial stability throughout the world. This growing stability was one of the most encouraging features of the business situation at the year's end. Copper felt the impulse of this.

Speculation in copper has been concentrated for many years in London. That market steadily advanced since Oct. 1 from £62 17s. 6d. to £68 7s. 6d. on Dec. 30. The advance in value of the pound sterling from $4.29\frac{1}{4}$ at beginning of 1924 to $4.72\frac{3}{4}$ at the close and the restoration of the German mark to its peace-time gold value will be most helpful to copper in England and Germany.

Notwithstanding the depressed value of the French franc and the Italian lire, the mills in those countries worked to capacity through 1924.

The war demand forced production in North and South America in 1918 to the peak figure of 1,297,000 tons; refinery production for 1924 is approximately 1,300,000 tons, the war production peak having been reached, indicating that most of the mines have been working at or close to capacity and that no material increase in production is probable.

Stocks, Refinery Production and Shipments, in Tons, and Price of Copper, 1919-1924

At End of	Stocks of Marketable Copper	Refinery Production North and South America	Domestic Shipments	Export Shipments	Total	Price Average for Year f.o.b. Refinery, Cents
1919	350,700	927,600	503,300	180,900	684,200	18 691
1920	320,700	835,400	626,200	239,600	865,700	17 456
1921	268,000	537,200	307,300	282,700	590,000	12 502
1922	149,400	788,800	549,800	357,600	907,400	13 382
1923	155,900	1,163,800	735,500	421,900	1,157,400	14 421
1924	136,434	1,300,332	753,389	566,395	1,319,784	13 024

Distribution of Refinery Shipments for Years 1923 and 1924

In Short Tons

Shipments to	1923 Tons	1923 Per Cent	1924 Tons	1924 Per Cent	Tons Increase
United States	735,521	63.55	753,389	57 09	17,868
Belgium	31,192	2.69	39,937	3 03	8,745
Canada	3,025	0.26	6,370	0 48	3,345
England	88,155	7.62	114,114	8 65	25,959
Far East	26,251	2.27	38,833	2 94	12,582
France	111,048	9.59	119,050	9 02	8,002
Germany	80,972	7.00	125,036	9 47	44,064
Holland	7,462	0.65	31,249	2 37	23,787
Italy	54,370	4.70	69,721	5 28	15,351
Norway and Sweden	13,230	1.14	14,931	1 13	1,701
Others	6,167	0.53	7,154	0 54	987
Total	1,157,393	100.00	1,319,784	100.00	162,391

The stock of marketable copper held by producers at the refineries in this country and South America is little more than one month's production. All of this and perhaps much more was sold for delivery in the early months of 1925. It would be difficult to supply the present demand with less stock, as consumers abroad are carrying no copper and are dependent on the producers for near-by shipments. The stocks of consumers in the United States are only normal.

In this country, now consuming 60 per cent of North and South American production, the outlook for the coming year never appeared better. The electric light and power industry raised in 1924 approximately $1,200,000,000 for extensions and additions to generating and distributing equipment. Easy money conditions are expected to continue and enable this industry to borrow funds to equip many large additional sources

of electrical energy throughout the country. Growth of the population and demand for living comforts account in part for these large expenditures; also the demand for lower costs of production by the use in industrial plants of cheaper power from centralized stations.

It is estimated that $342,000,000, exclusive of labor, will be spent in 1925, for new plant equipment and extensions by the electric railways of the United States—30 per cent more than in 1924. Certain of the large trunk line carriers are going ahead with the electrification of both terminal and stretches of main line where traffic is most condensed. The demand for telephone service and equipment established a record in 1924. The automotive industry, which took 100,000 tons in 1924, when production of cars was restrained, is planning on a materially increased output in 1925. The Copper and Brass Research Association continues its good work in extending the use of copper and brass, already having made substantial increases in the use of the metal and its alloys for housing.

A thorough study of the situation leads only to the prediction that 1925 will be the greatest copper year so far experienced, the record war years included. At the closing price for 1924 of 15c., copper is still cheap in comparison with the other two major non-ferrous metals, lead and zinc. As against the pre-war average price of 1910-13 inclusive, lead on Dec. 31, 1924, was 5c. per pound higher; zinc on Dec. 31, 1924, was 2c. per pound higher; and copper on Dec. 31, 1924, was only $\frac{1}{8}$c. per pound higher.

Lead Breaks Records

By Irwin H. Cornell
Vice-President and Sales Manager, St. Joseph Lead Co., New York

Irwin H. Cornell

THE BREAKING of all former production and of all consumption records in the United States were the outstanding features of the lead industry during 1924. Under the stimulus of good prices the mines of America are estimated to have produced 10 per cent more lead than was mined in the record year of 1916. There were three major price movements. The year opened with a strong market, a continuation of the rise in prices which started on Dec. 1, 1923. This upward movement continued without a break until the price exceeded 9c. a pound, New York. The highest price quoted by the *Mining Journal-Press* was 9.20c., New York, for the last two days of February. On March 1, 1924, the second movement began. A decline, starting slowly at first but gathering momentum during the first week of April, carried the price down until on May 23, 1924, it reached the lowest point of the year, 6.85c., New York, a drop of 2$\frac{1}{8}$c. per pound in a period of less than three months. For about sixty days prices remained fairly stationary. The third movement started on July 22, 1924, the upward swing carrying prices to 8c. on Aug. 15, 1924, when they were once more stabilized for about two months, to start up again on Oct. 11, 1924. The price level remained stationary at 8.65c., New York, for the month of November. On Dec. 2, 1924, the advance continued, until in the last days of the year it reached 9.70c. per pound, the highest point since the war year of 1917.

The curve of lead prices since the third quarter of 1922 would seem to lend color to the claim that there is a distinct seasonal demand for lead. The closing months of 1922, 1923, and 1924 have all seen actively rising prices, while in 1923 and 1924 low prices occurred in midsummer. On the other hand, in the fall of 1920 and 1921, prices for lead were low and the demand was small. It is probably a mere coincidence that the big declines of 1923 and 1924 started almost on the same day of March each year, and that the first advance after these declines of the official price of the American Smelting & Refining Co. were announced on July 23, 1923, and July 23, 1924, respectively. The fact that the curves of lead prices for 1923 and 1924 may be roughly called symmetrical will undoubtedly affect the buying public, and during the first two weeks of March, 1925, prices and conditions will be watched very carefully.

It is not the magic month of March that brings out high lead prices; in fact, before the war, March was generally considered a poor month. The causes of the two upward swings of price in 1924 were absolutely different. The first was brought about by great activity in the electrical industry of the United States, and more particularly by the great demands for lead batteries by the automotive industry in anticipation of a record spring demand for automobiles. This demand did not materialize, battery orders were canceled, and the battery manufacturers with heavy stocks of raw materials on hand were obliged to curtail purchases, and in some cases cancel orders for lead.

During the high prices of the first quarter of 1924, the price of lead in London was more than 2c. a pound below the price in New York. This condition kept all lead made from foreign ore in the United States and brought thousands of tons of Mexican pig lead into the United States for consumption, with the result that the bonded stocks in America, mostly represented by lead in ores and bullion in process of manufacture, had reached a high figure. During the last days of May the relation between the New York and London prices was quickly changed. The spread, which had been slightly over 2c. since the first of 1924, was reduced on June 5, 1924, to almost one-half of a cent a pound, and the flow of pig lead from Mexico was diverted from the United States to London and the Continent, and the stocks of bonded lead in America were exported.

The second bull movement starting in July, and, continuing throughout the remainder of 1924, was brought about by the London competition for Mexican lead. The

London Metal Exchange prices hardly show the extent of this competition, for prompt prices were often paid for shipment lead, and premiums over the London prices are paid for Continental delivery. The direct influence of London prices on the New York market is distinctly shown in the period from Aug. 15 to Oct. 9, 1924, during which time the London price seesawed around 6.50c. a pound, while the New York price remained at 8c. In spite of the impending Presidential election, the rapid advance in London during the second half of October was immediately followed by sharp advances in New York. The London price for pig lead during the last days of 1924, expressed in dollars, was higher than it had been at any time on record since the Civil War.

Outlook for 1925.—The new year commences with a bright outlook for the lead miner. There apparently has been no overexpansion in the battery industry; the cable business is good, as is also the paint industry.

The United States production of lead has increased and will probably continue to do so under the stimulus of the present price, but this added tonnage is needed to replace foreign lead. The price during the new year will be determined by the world supply and demand. The world demand will apparently be large, and unless the production in the countries outside of the United States can be materially increased, the price is bound to show a decided advance as a result of these strong basic conditions.

Outlook for Zinc

A Better Market and Perhaps Higher Prices

By E. N. Hickman
Executive Sales Department, The American Metal Company, Ltd., New York

E. N. Hickman

THE OUTLOOK for zinc is substantially better than it has been for many years. Conditions which peculiarly affect the status of zinc reveal three basic reasons for expecting the continuance of a sound market—improvement in domestic demand, increased demand from Europe, and a world-wide limitation of supplies. The United States galvanizing trade is brisk, improvement starting October, 1924, when sheet and tube manufacturers were consuming spelter at the rate of 14,500 tons per month, against 9,000 tons during midsummer, and 13,000 tons per month during the active early months of 1924. The largest interest is operating close to 80 per cent of capacity, and the others are working at 70 per cent.

Brass makers likewise are experiencing excellent business, and their expectations for 1925 warrant the belief that a record tonnage of zinc will be consumed by that industry. The same expectations hold for the sheet-zinc industry, which uses about 10 per cent of the total domestic zinc production. This industry, like galvanizing and brass, is nevertheless pursuing a conservative buying policy. The present understocked condition of the United States is indicated in the following table:

	Tons
Ore stocks in hands of producers, Jan. 1, 1924	53,400
Ore stocks in hands of producers, Jan. 1, 1925	26,600
Metal stocks at smelters, Jan. 1, 1924	37,220
Metal stocks at smelters, Jan. 1, 1925	21,208
Domestic deliveries, Jan.-March inc. 1924	130,937
Domestic deliveries, Sept.-Nov. inc. 1924	120,314
Sheet and Tube Galvanizing:	
Consumption, Jan.-March inc. 1924	39,831
Consumption, Sept.-Nov. inc. 1924	(*a*)41,172

(*a*) Improvement in galvanizing operations began in October and they have progressively advanced from that date.

Whereas prior to 1913 America and the Old World were independent with respect to zinc supplies, and though after the war an intermittent demand from Europe affected this market, the situation now presents a persistent need for our metal. European supplies were adequate while its consumption remained at the low scale enforced by war-time convalescence. During 1924 European production remained practically uniform, despite stimulation of high metal prices in the early and latter part of the year. Consumption increased steadily, particularly toward the last half of 1924, when England and Germany, the latter hitherto an exporter of zinc, began to import metal on an increasing scale. Both the galvanizing and brass trades in England are more active, and further increased consumption of metals is anticipated there. France, despite heavier ore imports, is importing metallic zinc on an increasing scale, the imports in 1924 being more than 50 per cent higher than those of 1923. A careful study of the foreign situation indicates that Europe will need more than 10,000 tons of metal per month from the United States.

It may fairly be stated that the same situation which prevails in the lead market, and which has made inevitable a permanently higher value for that metal, is encompassing the zinc market. World supply is not increasing—world consumption is. The United States is dependent largely on the Joplin-Miami-Kansas field, the output of which cannot be increased much above the current quantity, except at still higher ore prices, which may make available production from nearly exhausted and expensively worked properties. Demand for high-grade zinc is taking the principal Far Western ores to the chief electrolytic refinery.

In Canada, at the Sullivan mine, a new supply of zinc has become available as a result of the application of the selective flotation process to a large complex lead-zinc deposit. This supply is one of the few new zinc outputs of importance recently developed and should be readily absorbed.

Australia, once the mainstay of European spelter needs, is producing progressively less. In 1913 Aus-

tralian production, in the form of zinc concentrates, was about 500,000 gross tons, practically all of which were shipped to Europe. This was derived largely from the treatment of the accumulated surface dumps of zinc tailings. The dumps are practically exhausted; new mining operations are on a reduced scale, and the net result is that Australia today can produce no more than about 300,000 tons of concentrates per annum, or 40 per cent less than was available for Europe in 1913. Of the reduced tonnage about one-third is going to the electrolytic refinery at Risdon, Tasmania, the production of which is about 45,000 tons of zinc per year; the remainder has been largely going to Europe, but after April 1, 1925, it will go to England, leaving Continental smelters in sore need of fresh supplies.

From French Indo-China, northern Africa, Sardinia and Poland no increased production has appeared, and none can be expected unless new orebodies are discovered. Some alleviation of Continental smelting supplies has come from Mexico, where recently new production totaling about 10,000 tons of concentrates per month has been developed. Additional supplies from Mexico are being actively sought, particularly by European interests, with results to date quite expected by those most familiar with that country, but marketwise the tonnage is insignificant.

All factors governing the zinc industry point to a good market and possibly higher prices. This tendency can be jeopardized by temporary overproduction, excessive future commitments by consumers, or a definite turn in world-wide industrial activity. At this writing there are no such signs, and the outlook is one to hearten those who have seen the zinc industry through a long dark lane and now foresee the turning.

Gold Production Increases

World Position Improved—Small Gains in United States

By H. N. Lawrie
Assistant, U. S. Senate Commission of Gold and Silver Inquiry, Washington, D. C.

H. N. Lawrie

THE world's gold production in 1924 was about $384,500,000, an increase of approximately $17,600,000 over that of 1923, or 4.8 per cent. Increases of over $8,000,000 in the Transvaal, about $6,500,000 in Canada, and nearly $2,000,000 in Russia are indicated. Should December maintain the average monthly production of the year, the Transvaal production in 1924, estimated at $197,825,000, will establish a record. It is estimated that the Canadian production for 1924 will be about $31,500,000, of which the Province of Ontario will contribute about $25,000,000, each being a record figure. The entire production of North America, estimated at $100,200,000, is less than the production of the United States in 1915, $101,035,700. The 1924 production of the United States, estimated at less than $52,000,000, is practically the same as has prevailed for the last three years, or about 50 per cent of normal, indicating continued adverse economic conditions. No marked changes are shown in the production of other countries. In South Africa the exchange situation favored increased production; in Canada new discoveries contributed; in Russia it is reported that the need for gold for monetary requirements stimulated production.

Notwithstanding the favorable exchange situation in 1924 compared with that of 1923, there was during 1924 practically a continuous improvement in sterling exchange, reflected in the diminishing price for gold. The highest London gold quotation was recorded at 98s. per ounce on Jan. 21, 1924, compared with 96s. 11d. on Nov. 19, 1923; the low point in 1924, 88s., was reached on Dec. 30, compared with 87s. 5d. on Feb. 21, 1923. Indications point to a still further improvement in sterling exchange and the possible recovery of sterling to par during 1925, when the premium which the producers in South Africa have enjoyed will have altogether disappeared.

As an indication of the increased pressure of exchange conditions, it was reported in London on Nov. 23, 1924, that South Africa soon would experiment with minting of coin to determine whether it would cost less to mint than to pay the bank charges on the sale of bullion, which are considered excessively high. Recently the gold producers in Australia have been exempted from the payment of income tax to the Commonwealth Government, and the exemption also applies to dividends paid by gold-mining companies. Though relief from taxation will probably have the effect of stimulating prospecting and mining activities in Australia, which may result in increased production in 1925, it does not operate to reduce production cost and, consequently, does not change the economic status of the industry.

The Bureau of the Mint, with the co-operation of the U. S. Geological Survey, estimated that the refinery production of gold in the United States in 1924 amounted to $51,912,000, an increase of $178,000 over the production of 1923. In round numbers the principal increases in production occurred in Colorado, $1,900,000; Nevada, $500,000; Montana, $160,000; and the Philippines, $100,000; declines occurred in Arizona, $1,300,000; California, $400,000; Alaska, $300,000; South Dakota and Idaho, $200,000; and Utah, $100,000.

In 1920 the gold production in the United States was $51,186,900; in 1921, $50,067,300; in 1922, $48,849,100; in 1923, $51,734,000; and in 1924, $51,912,000. Producers anticipated that the deflation which took place in 1921 would greatly improve economic conditions in the industry. The production record indicates, how-

ever, that the increase in the purchasing power of the dollar, beginning in 1921, was not sufficient to encourage production, a fact which is demonstrated by the declines in production occurring in 1921 and 1922. The increase in 1923 was derived principally as an incidental product from the increased production of copper, and the increase of $178,000 in 1924 was attributable largely to the increased production that was made in the Philippines.

The purchasing power of the dollar receded continuously from 99c. in 1915, the peak of gold production, to 44.2 pre-war cents in 1920. In 1921, when the deflation took place, the purchasing power of the dollar increased to 68c., from which point it declined to 64.9c. in 1923, and recovered slightly, to 67c., during the first eleven months in 1924. In June the highest purchasing power for 1924 was recorded at 69.2c., and since there has been a decline, to 68.0c. in July, 66.8c. in August, 67.2c. in September, 65.8c. in October and 65.5c. in November. With this persistent and continuous decrease in the last half of 1924, further decreases in the purchasing power of the dollar may be expected in 1925. Heavy labor turnovers in many of the gold camps, some as high as 100 per cent; a shortage of competent labor, and a general decline in efficiency continue to contribute in keeping the industry in a subnormal condition.

The net imports of gold into the United States in the first eleven months of 1924 amounted to $287,460,414, compared with $262,142,698 in the corresponding period of 1923. In December, 1924, however, a large export of gold, $42,500,000, is reported from New York, with imports of $6,500,000.

The United States produced 21.5 per cent of the world's highest production in 1915—$468,799,812; and has since contributed a continually decreasing percentage, until in 1924 it was only 13.5 per cent. In 1925 the United States probably will become a still less important factor in the world's production, and with the very large increase which has been made in the production of Canada, it would seem probable that in a few years the Canadian production might exceed that of the United States, unless some constructive remedy is applied to improve domestic conditions. The field hearings conducted by the U. S. Senate Commission of Gold and Silver Inquiry in the principal mining camps of the West have been completed, and the testimony on the condition of the precious-metal industry during the past decade will soon be published as Serial 6.

Silver Shows Improvement

Coinage Outlet for the Metal in 1925 Indicated

By Felix Edgar Wormser
Assistant Editor, *Mining Journal-Press*

F. E. Wormser

A MODERATE movement in the price of silver is to be recorded for 1924. For the first ten months the metal advanced slowly but steadily, reaching a high point of 72⅛c. per ounce on Oct. 9. From that time on the market declined and ended the year at 66⅜c., not far distant from the opening price of 64⅜c. on Jan. 1, 1924. The entire period was significant for the splendid demonstration it gave of the well-known fact that in times of political stress and uncertainty the inhabitants of Asiatic countries tend to acquire gold and silver, metals which they realize can be moved from place to place readily and have a relatively high intrinsic value. Civil war in China was the moving influence in this instance and caused heavy purchases of silver to be made by China during the latter part of the year.

An important feature of the silver market has been the purchasing of silver by European countries that, a few short years ago, dispensed with it almost entirely, melting their own currencies in doing so. Now they are recoining silver. Reorganization or stabilization of disordered monetary systems has been an indispensable preliminary to the recoining and circulation of silver in Continental countries. Russia, the largest buyer, is reported to have taken about 32,000,000 oz. from London. Poland reorganized her currency and then dealt directly with a syndicate of four prominent American silver-refining companies for the purchase of 6,500,000 oz. of silver to be coined by the United States Mint into *zlotys*, the national coins of Poland. In August, Germany entered the domestic market with an order for 4,000,000 oz., also for coinage purposes. Further purchases were expected during the year, but they did not materialize. This buying came about the same time as the peak of the demand from China and helped to give the market great strength, carrying it to the high point of 1924. Oddly enough, both Chinese and Continental support of the market became weaker simultaneously toward the end of the year, so that the market fluctuations were sharper than they would have been had purchasing been distributed more uniformly.

World production of silver in 1924 will probably prove to be slightly below that of 1923. Production of the United States and Mexico in 1924 decreased, whereas Canadian output shows an improvement. The production of these three leading silver-mining countries is indicated in the accompanying table.

Silver Production

In Troy Ounces

	United States	Canada	Mexico	Total
1922	55,468,836	16,990,084	81,076,899	153,535,819
1923	66,163,338	17,017,074	90,810,855	173,991,267
1924	64,000,000	17,200,000	89,000,000	170,700,000

The efforts of silver producers to further their own interests collectively culminated during 1924 in the formation of a Silver Producers' Association, with both

large and small producers enrolled as full members.

Business continued to be done in 1924 directly with the Far East rather than through London, as was the custom in pre-war years. More than 72,000,000 oz. of silver was shipped directly from New York to India and 36,000,000 oz. to the Far East from San Francisco in the first eleven months of 1924. The advantages of direct shipment to the East are becoming more and more realized. The change that has occurred in the post-war years seems to be here for good, as it is sound market development. Shipments from London to the East were smaller in 1924 than in 1923. The comparative record is shown in the accompanying table.

Silver Shipments London to the Far East (*a*)

	To India	To China	Total
1922	£6,935,043	£3,376,900	£10,311,943
1923	8,562,421	2,075,750	10,638,171
1924 (11 months)	3,222,714	351,360	3,574,074

Silver Shipments From San Francisco

1923	58,520,926 oz.	1924 (11 mos.)	36,262,119 oz.

Silver Shipments From New York

	To England, Ounces	To India, Ounces
1922	16,280,716	18,167,836
1923	9,735,890	36,742,394
1924 (11 mos.)	30,652,352	72,594,202

(*a*) American Bureau of Metal Statistics.

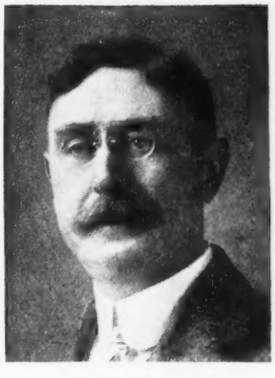
Production of silver may show an increase in 1925, especially if the copper and lead markets continue strong. Consumption in the United States may also show an increase if 1925 proves to be an exceptionally prosperous year, as many predict. But the underlying strength of the silver market and a determining factor in the price of silver will come, as heretofore, from India and China. The laconic comments "China selling," "bear covering from India" and kindred terms will carry the meat of market news. Stocks of silver in Shanghai are large. On Dec. 13, 1924, they totaled 84,900,000 oz., compared with a total of 45,800,000 oz. on Jan. 1, 1924. China is more likely to be seller than buyer at the moment.

An anticipated outlet for silver in 1925 is further purchasing by European countries. Now that the ball has started rolling, many European currencies stabilized or close to par and with others on the way, we may look for a stronger demand for silver from Europe than for many years.

Iron and Steel

Sharp Upturn in Demand at End of 1924

By B. E. V. Luty
Special Correspondent, *Mining Journal-Press*,
Pittsburgh, Pa.



B. E. V. Luty

THE YEAR 1924 fell behind 1923 in iron and steel production, but exceeded the other four post-war years. Production exceeded, also, that of any pre-war year.

The best measure of production is the steel ingot, for which a close estimate for 1924 can be made, in advance of the official statistics. Finished rolled steel is about 75 per cent of the ingot production, on account of scrap and scale losses. Production of steel castings is not included. Steel castings are cognate with iron castings rather than with rolled steel. The actual commercial steel as sold is somewhat under the rolled steel in tonnage, for the reason that rolled steel comprises skelp rather than pipe, wire rods rather than drawn wire, and exported blooms and billets rather than the finished rolled products made from them.

Steel ingot production in the six post-war years has been as follows:

	Gross Tons		Gross Tons
1919	33,694,795	1922	34,568,418
1920	40,881,392	1923	43,485,665
1921	19,224,084	1924	36,500,000

Steel production had increased rapidly before the war. It doubled from 1890 to 1897, seven years; from 1897 to 1902, five years; and from 1902 to 1912, ten years. Production in 1913, the immediate pre-war year, was practically the same as in 1912. The rapidity of the increase in the 90's was the result of steel supplanting wrought iron. In that period, and for a time afterward, rolled material gained more rapidly than iron castings. Pig-iron production did not increase as rapidly as steel production. Production of pig iron in 1924 was about 31,100,000 tons, against 30,966,152 tons in 1913, and 9,202,703 tons in 1890.

Though 1924 production was 16 per cent under 1923 production, it was 14 per cent above the average of the first four post-war years. Stocks of steel and steel manufactures were somewhat greater on Jan. 1, 1924, than a year before or a year after, so that actual consumption did not decrease as much as 16 per cent from 1923 to 1924. The two years together represented active conditions and a substantial recovery from the backset produced by the war. An average of 40,000,000 tons of ingot production was made in both years, or 24½ per cent above the average of the first four post-war years and 32 per cent above the largest two years preceding the war.

Therefore, given stable underlying conditions, with money easy and the world at peace and at work, there should be, in 1925, an increase in steel demand and consumption above the 40,000,000-ton average of 1923 and 1924. Output can reasonably be expected to average 45,000,000 tons or more, but operations at close to capacity can be expected only for relatively short periods, as capacity was augmented greatly by the war demand and is conservatively estimated to be 54,000,000

tons, or 35 per cent above the average production of the two best post-war years.

The course of demand and production in 1924 paralleled that of 1923, but the amount of fluctuation was much greater in 1923. A net decline in prices, contrasting with the advance in the first three months of 1923, occurred. In 1923 the peak production was reached in April, succeeded by a slow but continuous decline. In 1924, as a result of a short but sharp buying movement, production rose with extreme rapidity, and in March there was a record high rate of ingot production, estimated to be slightly more than 50,000,000 tons per annum. General business conditions were then found not to be so favorable, and buyers discovered, also, that mills had been able to make larger and prompter deliveries than they had expected when they placed their orders. A quick liquidation in stocks followed, whereby the rate of mill operations was rapidly forced down. July ingot production was less than 45 per cent of the March production.

Steel prices had softened while there was heavy buying, in December, 1923, and in the first two months of 1924, especially in steel for fabricated work and for freight-car construction. During the stock liquidation period prices diminished further, and as buying increased after mid-July they continued to weaken. Immediately after the election of Nov. 4, 1924, demand increased sharply, promising higher prices for the first quarter of 1925. A large amount of prompt business was driven in, and mill production in December, 1924, was fully 80 per cent of capacity, or nearly 10 per cent above the average of 1923-24. Tin plate, rails, and pipe, however, did not decline, retaining the 1923 top prices. The average of nearly all delivered prices, except rails, decreased slightly on account of the abolition, in September, 1924, of the "Pittsburgh Plus" pricing system.

Tin Supplies Short

Estimates for 1925 Indicate Maintenance of High Prices

By J. H. Lang
Tin Specialist, American Metal Co., 61 Broadway, New York

J. H. Lang

THE USUAL erratic price range of tin is shown by a glance at the accompanying table. The market in 1924 opened under the influence of a brisk speculation for the rise, which was brought to a sudden and dramatic conclusion by the operations of the Morgan pool for the stabilization of the French franc which raised the value of the latter 100 per cent—from 3.42c. in March to 6.85c. in April. It seemed that all Europe was "short" of francs. One of the favorite means of getting short was to buy commodities in francs, or to handle or finance the transaction in such a way that this was the ultimate effect. The London Metal Exchange had many such contracts. When the rise in francs came there was only one thing to do with these contracts, and that was to close them out. This precipitated an avalanche of selling in all metals, particularly in tin, which carried the price down nearly £100 per ton in London, and from 58¾c. to 40c. per pound in New York.

Conditions remained inherently sound, however, and a steady and sustained recovery went on during the next three or four months until £262 per ton was reached in London early in September; but confidence was not regained in the United States, where business suffered from election uncertainties, and the consumers refused to take any interest in the market beyond immediate requirements. Eventually this again provoked liquidation on a large scale, and in September a fall of about £35 per ton (7c. per lb.) occurred. From the low prices reached at that time there was a quick recovery, which still continues.

These wide fluctuations, as a result of speculative excesses, or to events entirely extraneous to the tin market, were bound to occur, but the position of tin itself, based on the fundamentals of supply and demand, remained excellent, as will be seen by an examination of the statistical tables presented.

Spot Straits Tin, London and New York (1924)

	London	New York	Exchange
Opened Jan. 2	£239–2 –6	44¾c.	$4.30
High	(*a*) 299–10	(*c*) 59c.	(*c*) 4.73⅞
Low	(*b*) 205–	(*b*) 40c.	(*d*) 4.20⅝
Closed Dec. 31	272–15	58¾c.	4.73½

(*a*) March 12. (*b*) May 23. (*c*) Dec. 30. (*d*) Jan. 22.

NOTE—It may interest consumers in the United States to point out, as shown by the above table, that the total advance of about 14c. per pound which they were compelled to pay during the year, was brought about by the rise in tin and the appreciation in sterling exchange.

Supplies and Deliveries of Tin in 1923 and 1924

Tons of 2,240 Pounds

Supplies	1924	1923	Increase in 1924		Decrease in 1924
Straits shipments	74,510	66,297	8,213	(*a*)	78
Australian shipments	1,533	1,611	.....	(*b*)	78
Banka shipments	15,961	15,393	568	(*c*)	.....
Standard shipments	16,132	17,790	.....	(*d*)	1,658
Total supplies	108,136	101,091	7,045	(*e*)	.....
Deliveries					
United Kingdom	17,982	18,641	.....	(*f*)	659
Continent	21,465	15,946	5,519	(*g*)	.....
Total Europe	39,447	34,587	4,860	(*h*)	.....
Total United States	64,160	70,154	.....	(*i*)	5,994
Total deliveries	103,607	104,741	.....	(*j*)	1,134
Visible Supply Jan. 1	18,631	22,281	.....	(*k*)	3,650
Visible supply Dec. 31	23,160	18,631	4,529	(*l*)	.....
Increase	4,529	.....	.....	(*m*)	.....
Decrease	.....	3,650	.....	(*n*)	.....
Invisible Supply Jan. 1	9,680	17,600	.....	(*o*)	7,920
Invisible Supply Dec. 31	.....	9,680	.....	(*p*)	9,680
Decrease	9,680	7,920	.....	(*q*)	.....

Combined Visible and Invisible Supply.

January 1	28,311	39,881	.....	(*r*)	11,570
December 31	23,160	28,311	.....	(*s*)	5,151
Decrease	5,151	11,570	.....	(*t*)	.....

(a) Straits Tin — Of the 74,510 Straits shipments 7,480

tons were ex pool and 67,030 tons ex production, against 6,120 tons ex pool and 60,177 tons ex production in 1923, showing an increased production of 6,853 tons—about 11¼ per cent or 570 tons per month. However, unless Straits can make a further like increase during 1925 (to offset lack of pool supplies), shipments will show an actual decrease in 1925.

(b) Australian Tin—Change negligible.

(c) Banka Tin—There was actually a decrease of about 1,000 tons of Banka shipment [instead of an increase of 568 tons as shown in the table]. The discrepancy is accounted for by the fact that statistics in 1924 contain shipments for thirteen months, against only twelve months, January-December, in 1923. Also the shipments in 1924 include 2,200 tons ex pool against 1,800 tons in 1923. This points to a production of only about 12,000 tons per annum and a consequent drop in shipments to that figure in 1925, unless mining operations are stimulated.

(d) Standard Tin—This item is misleading, as there was probably more standard tin produced in 1924 than in 1923. Less than half the Standard production is accounted for here. Some idea of the correct amount is obtainable from the following table of output from sources from which Standard tin is principally derived:

	1924	1923	Increase	Decrease
Nigerian (arrivals eleven months)	5,529	5,269	260	.....
Chinese (shipments twelve months)	7,534	9,257	....	1,723
Bolivian (shipments eleven months)	29,685	27,327	2,358	.....
Cornwall (estimated twelve months)	1,200	1,021	179	.....
	43,948	42,874	1,074	.....

(e)—Taking into consideration paragraphs *(a)*, *(b)*, *(c)* and *(d)* there is a net increase in production from all sources of 7,000 tons. Nevertheless, total stocks have been depleted more than 5,000 tons as shown in the foregoing.

(f), (g), (h) — These figures covering deliveries abroad are affected by the same inaccuracy that characterizes *(d)* in respect to Standard tin, but the relative showing (quite as important as the actual) is probably correct—namely, a substantial gain in deliveries abroad—a gain which is likely to continue and increase. In 1913 the total European deliveries compiled on the same basis as used here amounted to 44,062 tons, compared with 39,447 tons in 1924 and 34,587 tons in 1923. In the twelve years 1913-24 the United States has increased its consumption 40 per cent, while Europe is still 10 per cent behind its normal consumption.

(i), (j)—The decrease in the United States deliveries was at least twice what is shown here, because domestic production in 1923 (all delivered in the United States) was more than 5,000 tons. I put the total decrease at about 1,000 tons per month, or about 16 per cent. It is doubtful if actual consumption decreased to that extent. I have shown that the "invisible" East decreased 9,680 tons. The extent to which the "invisible" West has decreased I am unable to say.

(k) to *(t) inclusive*—These items should be considered as a whole. They show total stocks decreased in 1924, 5,151 tons as against a decrease of 11,570 in 1923. In other words, with 7,000 tons larger supplies and 1,100 tons smaller deliveries the rate at which stocks are being absorbed has only been slowed up. The process of attrition is still going on.

Conclusion—Though the present position is still sufficiently comfortable, assurances are unfortunately lacking as to just how long it will remain so. It is hoped that the production of Straits tin can be further increased, so that there will be no falling off in shipments from that source of supply. Bolivia seems to be the only source from which measurably larger quantities can be expected. Banka will probably not be able to do much, if any, better (perhaps not so well), and China, Nigeria, Australia, and other producing countries are negligible factors, so far as the immediate future is concerned. On the other hand, and especially considering the favorable outlook for business in the United States, it is not believed that the situation can be satisfied in 1925 on the basis of 1924 deliveries. As a result of this outlook it is conservative to estimate that consumption should be 10,000 tons of tin more in 1925 than in 1924, and Europe may easily require 5,000 tons in addition. Discounting these estimates 50 per cent, there is still the possibility of a deficit which may consume half the existing visible supply of tin within the year. The other half cannot be used. It is and of necessity must always remain in transit. At best, therefore, the prospect is for a very tight situation and the maintenance of high prices for tin until supplies increase or the world finds some substitute for its less essential requirements.

Yearly Average Prices of Principal Metals, 1895-1924

Prices in New York or St. Louis, cents per pound, except quicksilver (dollars per flask); silver and platinum (dollars per ounce). London quotations, pounds sterling per long ton.

	Copper		Lead		Tin		Zinc			Anti-mony,	Quick-silver,	Silver,	Plat-inum
	Electrolytic	Standard											
Year	New York	Lon-don	New York	Lon-don	*(f)* New York	*(a)* Lon-don	New York	St. Louis	Lon-don	New York	New York	New York	New York
1895	10.76*(b)*	.....	3.23	.....	14.05	63.333	3.63	.....	.....	7.560	39.58	65.250	.....
1896	10.88*(b)*	.....	2.98	.....	13.29	59.496	3.94	.....	.....	6.650	37.00	67.060	.....
1897	11.29*(b)*	.....	3.58	12.367	13.67	61.400	4.12	.....	.....	6.750	38.50	59.790	.....
1898	12.03*(b)*	.....	3.78	12.983	15.70	71.204	4.57	.....	.....	8.690	40.70	58.260	.....
1899	16.67	.....	4.47	14.933	25.12	122.429	5.75	.....	.....	9.430	43.63	59.580	15.22
1900	16.19	.....	4.37	16.987	29.90	133.575	4.39	.....	.....	9.500	51.00	61.330	18.09
1901	16.11	.....	4.33	12.521	26.74	118.633	4.07	.....	.....	8.250	47.00	58.950	20.00
1902	11.626	52.460	4.069	11.262	26.79	120.720	4.84	.....	.....	6.120	48.03	52.160	19.00
1903	13.235	57.970	4.237	11.579	28.09	127.320	5.40	5.191	.....	6.000	41.32	53.570	18.91
1904	12.823	58.884	4.309	11.983	27.99	126.733	5.100	4.931	.....	6.371	41.00	57.221	19.50
1905	15.590	69.465	4.707	13.719	31.358	143.083	5.882	5.730	25.433	10.250	38.50	60.352	20.34
1906	19.278	87.282	5.657	17.370	39.819	180.646	6.198	6.048	27.020	21.730	40.90	66.791	28.04
1907	20.004	87.007	5.325	19.034	38.166	172.638	5.962	5.812	23.771	14.840	41.50	65.237	30.98
1908	13.208	59.902	4.200	13.439	29.465	133.124	4.726	4.578	20.163	8.004	44.84	52.864	16.32
1909	12.982	58.732	4.273	13.042	29.725	134.774	5.503	5.352	22.185	7.466	46.30	51.502	24.87
1910	12.738	57.054	4.446	12.920	34.123	155.308	5.520	5.370	23.050	7.386	47.06	53.486	32.70
1911	12.376	55.973	4.420	13.970	42.281	192.353	5.758	5.608	25.281	7.540	46.54	53.340	43.12
1912	16.341	72.942	4.471	17.929	46.096	209.420	6.943	6.799	26.421	7.760	42.46	60.835	45.55
1913	15.269	68.335	4.370	18.743	44.252	201.679	5.648	5.504	22.746	7.520	39.54	59.791	44.88
1914	13.602	61.524*(c)*	3.862	19.076*(c)*	34.301	156.564*(c)*	5.213	5.061	22.544*(c)*	8.763	48.31	54.811	45.14
1915	17.275	72.532	4.673	22.917	38.590	163.960	13.230	13.054	67.533	30.280	87.01	49.684	47.13
1916	27.202	116.059	6.858	31.359	43.480	182.096	12.804	12.634	72.071	25.370	125.49	65.661	83.40
1917	27.180	124.892	8.787	30.500	61.802	237.563	8.901	8.730	52.413	20.690	106.30	81.417	102.82
1918	24.628*(d)*	115.530	7.413	30.100	*(e)*	330.138	8.159	7.890	54.180	12.581	123.47	96.771	105.95
1919	18.691	90.796	5.759	28.590	63.328	257.601	7.338	6.988	42.879	8.190	92.15	111.122	114.61
1920	17.456	97.480	7.957	37.832	48.273	295.866	*(e)*	7.671	44.372	8.485	81.12	100.900	110.90
1921	12.502	69.356	4.545	22.752	28.576	165.265	*(e)*	4.655	25.845	4.957	45.46	62.654	75.03
1922	13.382	62.123	5.734	24.097	31.831	159.450	*(e)*	5.716	30.003	5.471	58.946	67.521	97.618
1923	14.421	65.840	7.267	27.147	41.799	202.148	*(e)*	6.607	33.058	7.897	66.502	64.873	116.537
1924	13.024	63.149	8.097	34.421	49.674	248.737	*(e)*	6.344	33.728	10.836	69.761	66.781	118.817

(a) Prices of tin, London, from 1895 to 1914 from statistical report of Metallgesellschaft, Frankfurt-am-Main. *(b)* Prices 1895 to 1898 are for Lake copper. *(c)* Averages for nine months, no quotations being made during August, September and October. *(d)* Average of eleven months, no quotations being made in December *(e)* No average computed. *(f)* 99 per cent tin.

Estimates of Iron Ore Mined and Shipped in the United States in 1924 and Actual Output in 1923(*a*)

District	Ore Mined—Gross Tons 1923	Ore Mined—Gross Tons 1924	Ore Shipped 1923 Gross Tons	Ore Shipped 1923 Value	Ore Shipped 1924 Gross Tons	Ore Shipped 1924 Value
Lake Superior						
Michigan	14,174,468	12,333,000	14,065,561	$54,110,070	11,293,000	$35,554,000
Minnesota	44,348,296	31,837,000	44,556,053	158,402,788	31,120,000	94,605,000
Wisconsin	871,416	692,000	831,412	2,421,194	789,000	2,048,000
	59,394,180	44,862,000	59,453,026	$214,934,052	42,202,000	$132,207,000
Southeastern States:						
Alabama	6,783,146	6,842,000	6,922,663	$15,540,198	6,386,000	$13,333,000
Georgia	117,321	116,000	117,286	300,712	116,000	284,000
Missouri	53,546	86,000	54,348	247,975	86,000	392,000
North Carolina	59,684	11,000	59,684	161,603	11,000	28,000
Tennessee	267,275	187,000	266,175	677,753	186,000	411,000
Virginia	155,977	78,000	200,966	664,240	82,000	193,000
	7,436,949	7,320,000	7,621,122	$17,592,481	6,867,000	$14,641,000
Northeastern States:						
New Jersey	307,733	65,000	349,435	$1,403,723	99,000	$412,000
New York	541,922	250,000	722,096	3,242,229	305,000	1,419,000
Pennsylvania	993,441	782,000	988,586	2,264,485	781,000	1,240,000
	1,843,096	1,097,000	2,060,117	$6,910,437	1,185,000	$3,071,000
Western States	677,217	742,000	677,207	$1,301,951	742,000	$1,466,000
Grand total	69,351,442	54,021,000	69,811,472	$240,738,921	51,996,000	$151,385,000

(*a*) U. S. Geological Survey.

U. S. Production of Gold and Silver in 1924 (*a*)

States	Gold Ounces	Gold Value	Silver Ounces	Silver Value (*b*)
Alaska	300,907	$6,220,300	666,165	$447,663
Arizona	232,113	4,798,200	6,349,265	4,266,706
California	630,882	13,041,500	3,366,959	2,262,596
Colorado	408,667	8,447,900	3,286,996	2,208,861
Georgia	20	400	.....	.....
Idaho	26,809	554,200	8,035,193	5,399,650
Illinois	.....	.....	9,500	6,384
Michigan	.....	.....	153,201	102,951
Missouri	.....	.....	97,379	65,439
Montana	93,088	1,924,300	13,154,937	8,840,118
Nevada	223,159	4,613,100	9,523,846	6,400,025
New Mexico	24,207	500,400	783,338	526,403
North Carolina	14	300	.....	.....
Oregon	27,511	568,700	47,475	31,903
Pennsylvania	218	4,500	1,932	1,298
South Dakota	296,781	6,135,000	90,809	61,024
Tennessee	324	6,700	93,049	62,529
Texas	.....	.....	719,500	483,504
Utah	152,376	3,149,900	18,178,768	12,216,132
Washington	13,187	272,600	194,317	130,581
Wyoming	5	100	.....	.....
Porto Rico	10	200	11	7
Philippine Islands	80,965	1,673,700	39,576	26,595
Totals	2,511,243	$51,912,000	64,792,216	$43,540,369

(*a*) U. S. Geological Survey and Bureau of the Mint
erage New York price, $0.672 per ounce.

Production and Stocks of Refined Arsenic in the United States(*a*)

	Production 99 Per Cent Grade	Production Lower Grades	Stock at End of Year
1923	10,274	2,585	1,046
1924 (eleven months)	16,600	492	6,245

(*a*) American Bureau of Metal Statistics. Tons of 2,000 lb.

Production of Lead Refineries, 1919-1924 (*a*)

In Tons of 2,000 Lb.

Domestic	1919	1920	1921	1922	1923	1924 (*b*)
Desilverized	226,085	236,912	202,649	210,039	305,861	306,000
Antimonial	14,864	8,992	5,419	6,265	15,848	12,000
S. E. Missouri	158,182	206,836	142,804	203,327	182,221	222,000
S. W. Missouri	55,790	29,004	56,155	63,666	76,644	63,000
Totals	454,921	471,744	406,896	483,297	580,574	603,000
Foreign						
Desilverized	61,380	51,700	47,697	66,781	64,727	119,000
Antimonial	1,547	2,197	2,391	1,126	1,035	1,000
Totals	62,927	53,897	50,058	67,907	65,762	120,000
Grand totals	517,848	525,641	456,954	551,204	646,336	723,000

(*a*) Including lead derived from scrap and junk by primary smelters.
(*b*) U. S. Geological Survey estimate.

Zinc Smelter Production, 1919-1924

In Tons of 2,000 Lb.

	1919	1920	1921	1922	1923	1924
Arkansas	31,396	29,966	14,917	16,146	30,038	28,415
Colorado	2,779	1,682	1,200	.....	.....	.....
Illinois	118,631	109,483	52,183	77,929	81,484	96,062
Missouri-Kansas	43,347	25,131	31,784	23,966	46,603	32,927
Oklahoma	119,454	97,690	36,644	74,568	123,352	133,976
Electrolytic	25,962	57,441	11,553	55,349	71,073	77,498
East and others	130,115	158,379	67,333	125,720	178,652	166,968
Totals	471,684	479,772	215,614	373,678	531,202	535,846

Production for 1920, 1921, 1922, 1923, and 1924 through the courtesy of the American Zinc Institute.

Zinc Production, Stocks, and Retort Data

In Short Tons

	Production	Shipments	On Hand at End of Period
1920	479,772	446,199	71,058
1921	215,614	220,064	66,608
1922	373,678	422,034	18,252
1923	531,202	512,876	36,578

1924	Production	Shipments	Stocks at End of Month	Shipped From Plants for Export	Retorts Operating at End of Month
Jan.	49,709	45,590	40,697	3,798	78,768
Feb.	43,933	47,438	37,192	5,218	79,232
March	47,775	52,893	32,074	5,968	78,092
April	44,949	44,245	32,778	3,037	82,650
May	47,666	38,080	42,364	1,732	81,143
June	43,442	36,122	49,684	4,317	75,155
July	42,913	39,892	52,705	7,483	71,827
Aug.	41,775	43,558	50,922	6,743	72,195
Sept.	40,852	46,054	45,720	5,640	70,875
Oct.	42,488	49,756	38,452	8,299	72,139
Nov.	42,633	54,173	26,912	15,730	77,631
Dec.	47,711	53,411	21,208	10,307	81,274
Total	535,846	551,212		78,272	

Production of Slab Zinc by Various Countries,(*a*)

In Short Tons

	January to November, 1924		January to November, 1924
United States	488,135	Germany (*b*)	104,869
Canada	25,172	Australia	47,735
Belgium	163,062	Great Britain	38,999
			867,972

(*a*) American Bureau of Metal Statistics.
(*b*) Including Upper Silesia.

Ontario's Metal Production for the First Nine Months of 1924 (*a*)

Product	Quantity 1924	Quantity 1923	Value 1924	Value 1923
Gold, oz	894,812	705,183	$18,171,106	$14,577,315
Silver, oz	7,331,183	8,604,543	4,927,443	5,632,560
Platinum metals, oz	3,430	950	286,376	92,430
Nickel (metallic) tons	9,695	8,337	4,163,508	3,268,871
Nickel in matte exported, tons(*c*)	9,062	6,962	2,718,600	2,784,800
Nickel oxide, tons	(*d*) 3,553	4,275	1,482,609	1,224,091
Cobalt salts, lb	(*d*) 11,524	.....	35,466	.....
Cobalt (metallic) lb	142,154	210,176	346,177	531,699
Cobalt oxide, lb	(*d*) 225,966	327,912	620,587	638,969
Cobalt in unseparated oxides and residues, lb	(*d*) 295,705	481,049	396,123	182,305
Lead, pig, lb	3,764,546	3,291,518	274,338	214,644
Copper sulphate, lb	2,570	.....	.....	.....
Copper (metallic), tons	6,138	5,055	1,577,491	1,523,412
Copper in matte exported, tons(*c*)	6,050	4,368	1,089,000	873,600
Iron ore, tons(*d*)	43	7,594	110	26,452
Iron, pig, tons (*e*)	4,535	9,543	90,705	231,496
Bismuth, lb	12,683	.....	30,614	.....
Total	.....	.....	$36,210,384	$31,802,644

(*a*) Department of Mines, Toronto.
(*b*) Metallic content of compound.
(*c*) Copper in matte valued at 10 and 9c. per pound and nickel in matte at 20 and 15c. per pound in 1923 and 1924 respectively.
(*d*) Shipments to points other than Ontario blast furnaces.
(*e*) Total output of pig iron from both domestic and imported ore was 387,608 tons, woth $8,607,297. Figures in the table represent proportional product from Ontario ore, equivalent to 1.17 per cent of total.

Mining Dividends in 1923 and 1924

North and South American Companies

United States Company Name	Situation	Shares Issued	Par Value	1923 Per Share	1923 Total	1924 Per Share	1924 Total	Total Paid to End 1924	Latest Dividend Paid Date	Per Share
Ahmeek Mining, c	Mich.	200,000	$25	$2.50	$500,000	None	.....	$13,050,000	June, 1923	$1.50
*Alaska Goldfields	Alaska	250,000	2sh.	7½d.	£7,812	None	.....	.....	April. 1923	7½d.
*Alaska Treadwell Gold	Alaska	200,000	$25	None	.....	1.00	200,000	.....	Nov. 1924	$1.00
American Metal	Various	591,543	None	$3.00	1,642,978	3.00	1,773,395	.....	Dec., 1924	.75
American Metal pfd	Various	50,000	100	7.00	350,000	7.00	350,000	.....	Dec., 1924	1.75
*American Smelters Sec. pfd. "A"	Various	63,413	100	2.00	126,826	None	.....	73.648,622	Jan., 1923	2.00
*American Smelters Sec. pfd. "B"	Various	7,473	100	1.66⅔	12,455	None	.....	14.464,015	Jan., 1923	1.66⅔
American Sm. & Refining	Various	609,980	100	2.50	2,287,425	5.00	3,049,900	51,040,429	Nov., 1924	1.25
American Sm. & Ref. pfd	Various	500,000	100	7.00	3,500,000	7.00	3,500,000	86.296,386	Dec., 1924	1.75
Anaconda Copper Mining	Various	3,000,000	50	2.25	6,750,000	.75	2,250,000	.....	Jan., 1924	.75
*Arizona Commercial, c	Ariz.	265,000	5	.50	132,500	1.00	265,000	1,484.000	July, 1924	.50
*Bethlehem Steel	Various	1,801,519	100	5.00	7,767,074	3.75	6,755,696	.....	July, 1924	1.25
*Bethlehem Steel 7% pfd	Various	447,463	100	7.00	3,132,241	7.00	3,132,241	.....	Oct., 1924	1.75
*Bethlehem Steel 8% pfd	Various	146,503	100	8.00	1,172,024	8.00	1,172,024	.....	Oct, 1924	2.00
Betty O'Neal Mines, s,g	Nev.	400,825	5	.30	117,056	None	.....	117,056	May. 1923	.15
Bunker Hill & Sullivan, l,s	Idaho	327,000	10	5.00	1,635,000	6.25	2,043,750	30,915 750	Dec, 1924	1.00
Butte Copper & Zinc, z,l,s	Mont.	600,000	5	.50	300,000	.50	300,000	900 000	Dec., 1924	.50
California Rand Silver	Calif.	1,280,000	1	.54	691,200	.33	422,400	3,257,690	Dec. 1924	.01
Calumet & Arizona, c	Ariz.	642,532	10	3.50	2,248,834	2.00	1,285,064	51,734,155	Dec., 1924	.50
Calumet & Hecla Con. Copper	Mich.	2,005,502	25	.50	1,002,751	.50	1,002,751	.....	June, 1924	.50
*Cardiff Mining & Milling, s,l	Utah	500,000	1	.10	50,000	.20	100,000	1,025,000	Nov , 1924	10
Champion Copper	Mich.	100,000	25	7.00	700,000	7.80	780,000	3,530 718	May, 1924	7.80
Chief Consolidated, s,g,l	Utah	1,000,000	1	.40	356,480	.20	199,276	2,869,381	May. 1924	10
*Cleveland Cliffs Iron	Mich.-Minn.	398,296	None	.....	.....	.75	298,722	.....	Jan . 1924	.75
Colorado Fuel & Iron pfd	Colo.-Wyo.	20,000	100	8.00	160,000	8.00	160,000	.....	Nov . 1924	2.00
*Columbus-Rexall Consol. s,l,c	Utah	586,235	1	.05	29,361	None	.....	79,160	July, 1923	.05
Copper Range	Mich.	394,727	25	1.00	394,425	1.00	394,427	28,181.619	May 1924	1.00
Cresson Consol. Gold	Colo.	1,220,000	1	.40	488,000	.40	488,000	10.288 272	Oct . 1924	.10
Dragon Consolidated, s.c.l.g	Utah	1,875,000	1	.005	9,375	None	.....	271 875	De.., 1923	005
*Eagle & Blue Bell, l.s	Utah	893,146	1	.10	89,314	None	.....	761,284	1923	.....
Eagle Picher Lead	Okla.	1,000,000	20	2.25	180,000	4.70	1,010,000	.....	Dec.. 1924	.20
Eagle Picher Lead pfd	Okla.	8,656	100	6.00	51,936	7.00	60,592	.....	Oct 1924	1.50
*Federal Mng. & Smg. pfd	Idaho	120,000	100	7.00	839,034	7.00	840,000	18 662,871	Dec . 1924	1.75
General Development	Various	120,000	25	1.00	120,000	1.00	120,000	.....	Nov . 1924	.25
Golden Cycle Mng. & Red., g	Colo.	1,500,000	1	.08	120,000	.11	165,000	10,008,300	Dec.. 1924	.03
Great Northern Iron Ore	Minn.	1,500,000	None	3.00	4,500,000	4.00	6,000,000	53,625,000	Dec , 1924	2.00
*Great Western Mining, s	Nev.	1,330,000	.....	None	.....	.01	13,300	39,900	Nov . 1.24	.03
Hecla Mining, l.s	Idaho	1,000,000	.25	1.15	1,150,000	1.00	1,000,000	12,105,000	Dec , 1924	.25
*Hercules Mining, l.s	Idaho	.....	.....	.....	800,000	.....	500,000	.....	.....	.....
*Homestake Mining, g	S. D.	251,160	100	6.00	1,506,960	7.00	1,758,120	47,131.594	Dec., 1924	.50
*Inland Steel	Minn.	1,182,799	None	2.50	2,471,313	2.50	2,517,516	.....	Dec., 1924	.625
*Inland Steel pfd	Minn.	100,000	100	5.25	525,000	7.00	700,000	.....	Oct , 1924	1 75
Inspiration Consol. Copper	Ariz.	1,181,967	20	1.50	1,772,950	.50	590,983	41,347.635	Jan., 1924	.50
Iron Blossom Consol., s.l.g.	Utah	1,000,000	10	.10	100,000	.05	50,000	3.525,000	Oct , 1924	.025
Iron Cap Copper	Ariz.	142,100	10	.15	21,315	None	.....	1,053,208	May. 1923	.15
Isle Royale Copper	Mich.	150,000	25	1.50	225,000	None	.....	2,400,000	Sept . 1923	.50
*Kennecott Copper	Alaska	3,997,473	None	3.00	9,990,071	3.00	11,992,419	75,484,901	Oct.. 1924	.75
Miami Copper	Ariz.	747,114	5	2.00	1,494,228	2.00	1,494,228	28,927,571	Nov , 1924	.50
*Mohawk Mining, c	Mich.	115,000	25	3.00	345,000	None	.....	10,320,000	Oct., 1923	1.00
*Mother Lode Coalition, c	Alaska	2,500,000	None	1.00	2,500,000	.75	1,875,000	6,875,000	Dec , 1924	.375
*National Lead	Mo.	206,554	100	8.00	1,652,432	8.00	1,652,432	15,646,465	Dec , 1924	2.00
*National Lead pfd	Mo.	243,676	100	7.00	1,705,732	7.00	1,705,732	28,997.444	Dec , 1924	1.75
New Cornelia Copper	Ariz.	1,800,000	5	.75	1,350,000	.75	1,350,000	5,850,000	Nov , 1924	.25
*New Jersey Zinc	Various	454,664	100	10.00	4,546,640	10.00	4,546,640	.....	Nov , 1924	4.00
*Ohio Copper	Utah	2,893,120	None	.....	.....	.05	144,656	144,656	Dec., 1924	.05
Osceola Consol. Copper	Mich.	96,150	25	2.00	192,300	None	.....	18,140,975	June, 1923	1.00
*Park City Mng. & Smg., s.l.z	Utah	876,000	5	.50	438,400	.60	525,600	964.000	Oct., 1924	.15
*Park Utah Mining, s.l	Utah	1,000,000	1	.60	600,000	.30	300,000	1,296,037	April. 1924	.15
Phelps Dodge, c	Ariz.-Mex.	500,000	100	4.00	2,000,000	4.00	2,000,000	.....	Oct., 1924	1.00
*Republic Iron & Steel pfd	Mich.-Ala.	250,000	100	13.00	3,250,000	10.00	2,500,000	.....	Oct., 1924	1 75
St. Joseph Lead	Mo.	1,549,380	10	2.00	3,098,752	2.00	3,098,758	30,584,425	Dec., 1924	.50
St. Mary's Mineral Land, c	Mich.	160,000	25	4.00	640,000	3.00	480,000	.....	May, 1924	3.00
Silver King Coalition, s.l	Utah	1,216,100	5	.70	851,270	.60	729,660	17,569,955	Oct , 1924	.15
*Silver Wave Mine, s	Utah	647,500	1	.001	647	.....	647	3,885	Sept., 1924	.001
*Sloss-Sheffield Steel & Iron	Ala.	100,000	100	None	.....	6.00	600,000	.....	Dec , 1924	1.50
*Sloss-Sheffield S. & I. pfd	Ala.	67,000	100	7.00	469,000	7.00	469,000	.....	Oct., 1924	1.75
*Tamarack & Custer Consol., l.s	Idaho	1,877,288	1	.....	400,000	.....	300,000	1,032,215	Sept , 1924	.....
*Tecopa Consolidated, s.l	Calif.	3,000,000	1	.015	45,000	.01	30,000	.....	April, 1924	.01
*Tennessee Copper & Chem	Tenn.	794,504	None	.75	607,946	.25	198,626	.....	Jan., 1924	.25
Texas Gulf Sulphur	Texas	635,000	10	6.25	3,968,750	7.50	4,762,500	12,541,250	Dec., 1924	2.25
Tintic Standard Mining, l.s	Utah	1,161,700	1	.50	581,750	1.00	1,148,300	3,562,057	Dec., 1924	.20
*Tomboy Gold Mines	Colo.	310,000	£1	None	.....	9d.	£11,625	£860,625	Nov., 1924	9d.
Tonopah Belmont Dev., s.g	Nev.	1,500,000	$1	$0.10	150,000	None	.....	$10,793,063	April, 1923	$0.05
*Tonopah Divide Mining, s.g	Nev.	1,014,800	1	.20	202,960	None	.....	202,960	Oct., 1923	.10
*Tonopah Extension Mng., s.g	Nev.	1,392,715	1	.30	417,815	$0.20	$278,543	3,783,699	Oct., 1924	.05
Tonopah Mining, s.g	Nev.	1,000,000	1	.30	300,000	.15	150,000	15,625,000	Oct., 1924	.075
Union Copper Land & Mng	Mich.	80,000	25	.50	40,000	.50	40,000	520,000	Nov., 1924	.50
United Eastern Mining, g	Ariz.	1,363,000	1	.60	817,800	.30	408,900	5,997,200	July, 1924	.05
*United Gold Mines	Colo.	4,800,000	1	None	.....	.01	48,000	609,179	Feb., 1924	.01
U.S. Smelting, Ref. & Mng. pfd., s. l. c	Various	486,350	50	3.50	1,702,225	3.50	1,702,225	31,690,167	Oct., 1924	.875
*U.S. Steel	Various	5,083,025	100	5.25	26,685,881	7.00	35,581,173	593,421,311	Dec., 1924	1.75
*U. S. Steel, pfd	Various	3,602,811	100	7.00	25,219,677	7.00	25,219,677	622,490,107	Nov., 1924	1.75
*United Verde Copper	Ariz.	300,000	None	8.25	2,475,000	11.00	3,300,000	.....	Dec., 1924	2.00
United Verde Extension, c	Ariz.	1,050,000	.50	3.50	3,675,000	2.50	2,625,000	21,892,500	Nov., 1924	.50
Utah-Apex Mining, s.l	Utah	528,200	5	.75	396,150	.25	132,050	.....	Sept., 1924	.25
Utah Copper	Utah	1,624,490	10	4.00	6,497,960	4.00	6,497,960	131,815,787	Dec., 1924	1.00
*Virginia Iron, Coal & Coke	Va., Ky.	100,000	100	3.50	349,810	1.50	150,000	.....	Jan , 1924	1.50
*Virginia Iron, Coal & Coke, pfd	Va., Ky.	50,000	100	5.00	250,000	5.00	250,000	.....	July, 1924	2.50
*West End Consolidated, s.g	Nev.	1,788,486	5	.05	89,424	None	.....	1,877,910	Mar , 1923	.05
*Yellow Pine Mining, s.l.z	Nev.	1,000,000	1	.04	40,000	.08	80,000	.....	Dec. 1924	.04
Foreign										
*Ahumada Lead	Mex.	1,187,020	1	None	.....	5.25	623,185	623,185	Oct., 1924	.15
Amparo Mining, g.s	Mex.	2,000,000	1	.12	240,000	.10	200,000	4,732,177	Nov , 1924	.02
*Aramayo Mines, s.t.b.c	Bolivia	600,000	Sw.fr.25	Sw.fr.5	3,000,000	7.75	4,650,000	.....	Nov., 1924	1.5
*Asbestos Corporation	Que.	30,000	$100	$5.50	165,000	None	.....	1,035,000	Oct., 1923	$1.00
*Asbestos Corporation, pfd	Que.	40,000	100	6.75	270,000	6.00	240,000	2,150,000	Oct., 1924	1.50
*British Platinum & Gold	Colombia	596,614	£1	None	.....	1 sh.	£29,831	.....	July, 1924	1sh.
Cerro de Pasco Copper	Peru	1,122,662	None	3.00	$2,971,686	$4.00	$4,413,608	.....	Nov., 1924	$1.00
*Chile Copper	Chile	4,391,060	$25	2.50	9,500,000	2.50	9,500,000	19,000,000	Dec., 1924	.625
*Chontalpan y an	Mex.	14,000	Pesos 25	.....	.....	.....	.....	.....	.....	.....
*Coniagas Mines, s	Ont	800,000	$5	.25	200,000	.125	100,000	11,340,000	May, 1924	.125
Consolidated M. & S., l.z.c.s	B. C.	427,774	25	None	.....	2.00	952,189	8,046,085	July, 1924	.75
Dolores Esperanza, g.s	Mex.	864,087	2	.15	129,608	None	.....	216,013	July, 1923	.05
Dome Mines, g	Ont.	1,000,000	None	3.00	1,430,001	2.00	2,000,000	.....	Oct., 1924	.50
El Oro Mining & Ry., g.s	Mex.	1,147,500	£1	6d.	£28,687	6d.	£28,687	£2,280,656	Dec., 1924	6d.
*Erupcion Mining	Mex.	1,250,000	$1	$0.125	$156,250	$0.575	$718,750	$875,000	Oct , 1924	$0.15
*Frontino & Bolivia Gold	Colombia	140,000	£1	.....	.....	1sh.	£7,000	.....	July, 1924	1sh.

Mining Dividends in 1923 and 1924 (Concluded)

*Frontino & Bolivia, pfd	Colombia	23,390	1	2sh.	£2,339	2	2,339	.....	.....	.....
*Hollinger Consol. Gold	Ont.	4,920,000	$5	$0.65	$3,198,000	$0.65	$3,198,000	$26,152,000	Dec., 1924	$0.05
Howe Sound, c	B. C., Mex.	1,984,150	1	.10	198,415	.10	198,415	1,587,320	April, 1924	.05
International Nickel, pfd	Ont.	89,126	100	6.00	534,756	6.00	534,756	10,160,250	Nov., 1924	1.50
Keeley Silver Mines, s	Ont.	2,000,000	1	.16	320,000	.24	480,000	800,000	Sept., 1924	.12
*Kerr Lake Mines, s	Ont.	600,000	4	.50	300,000	.25	150,000	9,435,000	Oct., 1924	.125
Lake Shore Mines, g	Ont.	2,000,000	1	.08	160,000	.19	380,000	1,020,000	Dec., 1924	.10
La Rose Mines, s	Ont.	1,500,000	1	.10	150,000	None	.....	7,805,410	Mar., 1923	.10
Lucky Tiger-Combination, g	Mex.	715,337	10	1.07	765,411	1.17	836,944	10,566,982	Dec., 1924	.16
McIntyre Porcupine Mines, g	Ont.	798,000	5	.75	548,542	1.00	774,125	4,409,408	Dec., 1924	.25
*Mexico Mines of El Oro, g.s	Mex.	210,000	£1	£1	£210,000	11sh.	£115,500	.....	Dec., 1924	5sh.
*Mond Nickel	Ont.	900,000	£1	2sh.	£90,000	2sh.6d.	£112,500	.....	July, 1924	1s.6d.
*Mond Nickel, cum. pfd	Ont.	500,000	£1	1s.8d.	35,000	1s.8d.	35,000	.....	July, 1924	14d.
*Mond Nickel, non-cum. pfd	Ont.	2,000,000	£1	1s.8d.	140,000	1s.8d.	140,000	.....	July, 1924	14d.
N. Y. & Honduras Rosario, s.g	Honduras	200,000	$10	$1.25	$250,000	$1.75	$350,000	$6,020,000	Dec., 1924	$0.50
Nipissing Mines, s	Ont.	1,200,000	5	.90	1,080,000	.90	1,080,000	26,520,000	Oct., 1924	.30
*Oroville Dredging, g	Colombia	715,636	£1	3sh.	£107,345	None	.....	.....	Dec., 1923	9d.
*Ouro Preto Gold	Brazil	39,429	£1	.....	.....	2s.6d.	£4,928	.....	May, 1924	1s.6d.
*Ouro Preto Gold, pfd	Brazil	42,656	£1	2sh.	£4,266	2sh.	4,266	.....	Oct., 1924	1sh.
*Pato Mines (Colombia), g	Colombia	100,000	£1	£1 1sh.	105,000	.....	.....	.....	Sept., 1923	7 sh.
*Penoles Mining, l.z.s.g	Mex.	300,000	Pesos 30	None	.....	$1.50	$450,000	$450,000	Dec., 1924	1s.6d.
Premier Gold, s.g	B. C.	5,000,000	$1	$0.34	$1,700,000	.24	1,200,000	6,050,000	Oct., 1924	$0.08
St. John del Rey, g	Brazil	546,265	£1	.....	.....	3sh.	£96,097	.....	Dec., 1924	9d.
*St. John del Rey, 1st pfd	Brazil	100,000	1	2sh.	£10,000	2sh.	10,000	.....	Dec., 1924	2sh.
*San Francisco Mines, l.z.s.g	Mexico	1,503,959	10sh.	1s.6d.	112,691	1s.3d.	93,997	£206,688	June, 1924	1s.3d.
Silversmith Mines, s l.z	B. C.	2,500,000	$0.20	$0.06	$150,000	$0.07	$175,000	$450,000	Oct., 1924	$0.01
Wright-Hargreaves Mines, g	Ont.	2,750,000	1	.075	206,250	.125	343,750	$962,500	Dec., 1924	.05

* From published reports; official data not supplied; c. copper; s, silver; g, gold; l, lead; z, zinc; t, tin; b, bismuth.

Important Mining Stocks in 1924

Company	Exch.	High		Low		Last	Sales
COPPER							
Alaska-Br. Col.	N.Y. Curb	*40	Feb.	*6	Dec.	*6	25,000
Anaconda	New York	48¼	Dec. 29	28⅛	May 20	47⅛	1,750,139
Arcadian Con.	Boston	3½	Dec. 27	*75	June 16	2⅝	33,275
Arizona Com'l	Boston	16	Dec. 27	8	Jan. 2	14⅜	77,075
Calaveras	N.Y. Curb.	3	Nov.	1	Feb.	2	16,300
Calumet& Ariz.	New York	58½	Dec. 29	41⅞	Mar. 31	57½	66,400
Calumet&Hecla	Boston	195	Jan. 7	134	May 19	185	125,566
Canario	N. Y. Curb	4½	Oct.	1⅞	May	4⅛	660,120
Cerro de Pasco	New York	56⅛	Dec. 29	40⅛	Mar. 31	54⅞	1,018,700
Chile Copper	New York	38⅛	Dec. 29	25⅝	Mar. 29	37	1,218,600
Chino Copper	New York	29	Dec. 27	15	Mar. 28	28	209,200
Con.Cop.Mines	N.Y. Curb.	4	Aug.	1¼	Jan.	3¼	388,500
Copper Range	Boston	33⅜	Dec. 27	18¼	June 6	31½	73,174
Crystal Copper	Boston Curb	*95	Aug.	*40	Oct.	*60	.....
Davis Daly	Boston	4⅜	Jan. 23	3⅝	Jan. 3	4½	22,795
East Butte	Boston	6⅛	Dec. 27	3¼	July 15	6	42,428
First National	Boston Curb	*40	Nov.	*23	April	*35	.....
Franklin	Boston	1	Jan. 8	*40	May 24	*95	9,463
Gadsden Cop.	Boston Curb	*90	July	*30	Feb.	*64	.....
Granby Consol.	New York	21⅞	Dec. 27	12½	April 14	20½	177,300
Greene-Canan.	New York	21⅞	Dec. 29	10	May 16	19	60,400
Hancock	Boston	2	Jan. 28	*30	Oct. 27	1¼	4,112
Howe Sound	N.Y. Curb.	3½	Dec.	1⅞	June	3⅛	112,800
Inspira. Con.	New York	33¾	Dec. 29	22⅛	Feb. 28	32	445,600
Iron Cap	Boston Curb	4	July	1⅛	Dec.	2⅛	.....
Isle Royale	Boston	22⅛	Dec. 27	12	Jan. 7	19⅜	17,934
Jerome Verde	N.Y. Curb.	2	Jan.	*76	July	*98	36,200
Kennecott	New York	57⅞	Dec. 27	34⅛	Jan. 21	55⅛	2,479,500
Keweenaw	Boston	1⅛	Dec. 26	*50	Jan. 7	1¾	6,670
Lake Copper	Boston	3½	Dec. 29	*90	April 3	3	9,685
Magma Cop.	New York	45⅜	Dec. 29	26⅛	June 14	42⅛	437,200
Mason Valley	N.Y. Curb.	2⅛	Dec.	1¼	June	2⅞	90,600
Mass Consol.	Boston	1¾	Aug. 20	*50	Jan. 8	1⅞	7,150
Miami Copper	New York	25	Aug. 18	20	May 19	23	204,277
Michigan	Boston	*75	Jan. 15	*50	Feb. 1	*50	20
Mohawk	Boston	41	Dec. 29	23⅞	June 13	38⅜	25,482
Mother Lode	New York	9¼	Feb...15	6	May 19	9	668,200
Nevada Consol.	New York	16⅞	Dec. 29	11⅞	Jan. 2	16	269,000
New Cornelia	Boston	25⅜	Dec. 29	16½	Jan. 2	25	65,948
New Dominion	Boston	2⅞	Mar. 14	*40	Dec. 2	*40	89,081
North Butte	Boston	6⅜	July 26	1⅞	Oct. 7	2⅞	90,220
Ohio Copper	N.Y. Curb.	1⅞	Dec.	*65	March	1⅜	1,247,500
Old Dominion	Boston	28½	Dec. 27	15	Jan. 30	25⅜	29,148
Phelps Dodge	Open Mar.	145	Jan.	99	July	108½	.....
Quincy	Boston	34¾	Dec. 27	14	June 10	31	19,984
Ray Consol.	New York	17⅛	Dec. 5	9	Mar. 27	16¾	885,350
Ray Hercules	N.Y. Curb.	*33	Feb.	*5	Dec.	*15	241,600
St.Mary's M.L.	Boston	49	Dec. 29	26	June 16	46	35,144
Seneca Copper	New York	6¼	Jan. 11	*50	May 22	1	147,750
Shannon	Boston	1⅜	Sept. 13	*30	April 2	1¼	58,355
Shattuck- Ariz.	New York	8	July 23	4	April 11	8	39,800
South Lake	Boston	*75	Dec. 27	*25	July 19	*75	200
Super.&Boston	Boston	2⅛	Dec. 29	*25	Aug. 19	2⅛	57,545
Tenn. C.&C.	New York	9⅜	Jan. 5	6⅛	Mar. 31	9	53,925
Tuolumne	Boston	*50	Feb. 7	*10	Jan. 24	*42	7,412
UnitedVerdeEx	N.Y. Curb.	30½	July	21⅛	June	30	65,400
Utah Copper	New York	88¾	Dec. 27	64	Jan. 18	87⅞	182,360
Utah M.&T.	Boston	*70	July 22	*14	June 18	*50	76,073
Victoria	Boston	1	Aug. 18	*50	June 25	*90	4,030
Walker	N.Y. Curb.	3 11/16	Dec.	2½	Jan.	3½	87,000
Winona	Boston	*70	July 22	*13	Feb. 6	*20	19,570
ZINC							
Am. Zinc L.&S.	New York	12½	Dec. 29	7	Mar. 29	11⅞	87,000
Am. Z.L.&S.pfd	New York	36⅞	Dec. 27	24	June 5	34½	72,800
Butte C.&Zinc	New York	9¼	Dec. 1	3⅜	June 25	8⅛	212,400
Butte&Superior	New York	25½	Dec. 27	14	May 29	23⅛	268,000
Callahan Z.&L.	New York	5⅞	Jan. 9	2½	May 10	4⅛	207,190
N. J. Zinc	N.Y. Curb.	197	Dec.	134½	May	194¼	16,141
United Zinc	N.Y. Curb.	*40	Dec.	*15	Dec.	*15	12,100
Yellow Pine	Los Angeles	*82	Jan.	*57	Sept.	*75	.....

Company	Exch.	High		Low		Last	Sales
LEAD							
Carnegie L&Z.	Pittsburgh	6	April	1⅜	May	4⅜	110,684
Natl Lead	New York	169¼	Aug. 15	123½	April 21	151⅞	351,475
Natl. Lead pfd.	New York	118	Sept. 9	111½	May 27	116¼	12,435
St.Joseph Lead	New York	45⅞	Dec. 16	22	Jan. 7	45½	218,299
SILVER							
Alvarado	N.Y. Curb.	3	Oct.	*90	Aug.	1¾	1,700
Beaver Consol.	Toronto	*34½	Jan.	*13½	July	*26¾	.....
Candelaria S.	N.Y. Curb.	*3	Jan.	*1	Feb.	*1	236,800
Castle-Treth	Toronto	*81	April	*56	Feb.	*73	.....
Coniagas	Toronto	2.30	Dec.	1.15	July	2.20	.....
Keeley	Toronto	2.68	Jan.	1.73	Jan.	2.17	.....
Kerr Lake	N.Y. Curb.	2¼	Jan.	1½	March	1⅞	25,800
La Rose	Toronto	*29½	Jan.	*4	Nov.	*6	.....
Lorrain T.L.	Toronto	1.46	Sept.	1.08	Jan.	1.31	.....
McKin.Da.Sav.	Toronto	*16¼	March	*9	Nov.	*17	.....
Mining Corp.	Toronto	3.99	Feb.	2.30	July	3.00	.....
Nipissing	N.Y. Curb.	6⅞	Nov.	5⅜	Jan.	6⅛	91,200
Ontario Silver	New York	8⅜	Oct. 14	4⅞	Aug. 11	6⅛	11,200
Temiskaming	Toronto	*32½	Jan.	*16¼	Oct.	*20	.....
NICKEL-COPPER							
Internat.Nickel	New York	27⅛	Dec. 27	11⅛	May 9	26⅛	1,705,600
Int. Nickel pfd.	New York	95	Nov. 10	75½	May 29	93⅞	14,035
GOLD							
Alaska Gold	New York	*25	Jan. 30	*5	Dec. 24	*15	57,400
Alaska Juneau	New York	1⅜	Mar. 4	⅞	Jan. 30	1⅛	116,050
Argonaut	Toronto	*65	Jan.	*20½	Nov.	*34	.....
Carson Hill	Boston	3¼	Jan. 22	*37	Nov. 15	*59	56,612
Con.W.DomeL.	Toronto	*32	Jan.	*14½	Oct.	*17	.....
Cresson Con.	N.Y. Curb.	4¼	Jan.	3¼	Oct.	3½	94,100
Crown Reserve	Toronto	*76	Jan.	*43	Sept.	*50	.....
Dome	New York	20¼	Jan. 7	11¼	Nov. 19	13¼	208,800
Golden Cycle	Colo.Spgs.	1.39	May	1.20	Jan.	1.38	.....
Hollinger Con.	Toronto	15.50	Dec.	11.40	March	15.50	.....
Homestake	New York	56½	Jan. 3	35	July 1	43	33,300
Jib Consol	N.Y. Curb.	*95	July	*15	March	*55	5,207,230
Kirkland Lake	Toronto	*30	Dec.	*13½	Jan.	*30	.....
Lake Shore	Toronto	4.50	Dec.	3.46	Jan.	4.50	.....
McIntyre-Porc.	New York	18¼	Jan. 7	14⅜	Dec. 11	15¾	84,900
Newray	Toronto	*45	Jan.	*19½	Aug.	*24	.....
Night Hawk P.	Toronto	*97	March	*26	Nov.	*28	.....
Portland	Colo.Spgs.	*63	April	*39	Dec.	*40	.....
Rand Mines	New York	33⅛	Nov. 5	30	Jan. 17	33	3,700
Teck-Hughes	Toronto	1.34	Jan.	1.04	June	1.25	.....
Tom Reed	Los Angeles	*56	Jan.	*17½	Aug.	*40	.....
Tough-Oakes	Toronto	*75	Feb.	*33	Nov.	*40½	.....
United Eastern	N.Y. Curb.	1 1/16	Jan.	*35	Oct.	*35	.....
Vipond Con.	Toronto	1.40	Jan.	*95	Feb.	1.35	.....
Wright-Harg.	Toronto	4.00	July	2.75	Jan.	4.00	.....
GOLD-SILVER							
Black Oak	N.Y. Curb.	1½	Sept.	*34	Jan.	*89	356,300
Con. Cortez	N.Y. Curb.	*70	March	*10	June	*10	1,002,500
Con Virginia	San Fran.	*9½	Dec.	*3	Jan.	*9½	.....
Continental	N.Y. Curb.	4	Jan.	1	Dec.	1¼	900
Dolores Esper.	N.Y. Curb.	*70	Feb.	*26	Dec.	*26	39,500
Premier Gold	N.Y. Curb.	2⅞	Nov.	1¾	April	2¼	85,700
TonopahBelmt.	N.Y. Curb.	*75	Feb.	*46	April	*58	51,700
Tonopah Div.	N.Y. Curb.	*40	Jan.	*17	May	*20	122,300
Tonopah Ext.	N.Y. Curb.	3 5/16	Nov.	1½	Jan.	3 5/16	220,810
Tonopah Mng.	N.Y. Curb.	2⅛	July	1 1/16	Jan.	1⅞	66,700
Unity Gold	N.Y. Curb.	2 5/16	Feb.	*56	Dec.	*57	75,100
West End Con.	N.Y. Curb.	*86	Jan.	*30	June	*46	76,626
Yukon Gold	N.Y. Curb.	*80	Jan.	*50	May	*50	22,200

Company	Exch.	High		Low		Last	Sales
SILVER-LEAD							
Ahumada	Boston Curb	9⅜	Dec.	4⅞	Jan.	9⅜	.....
Bingham	Boston	31⅛	Dec. 31	14	June 13	31⅛	56,092
Cardiff M.&M.	Salt Lake	1.15	Nov.	*65	Jan.	1.15	.....
Chief Consol.	Salt Lake	4¼	Jan.	2⅜	Nov.	3⅛	.....
Columb. Rexall	Salt Lake	*31½	Jan.	*12	Sept.	*26	.....
Daly	Salt Lake	2.25	Aug.	1.30	.....	1.50	.....
Erupcion	Boston Curb	2⅞	Sept.	1⅛	Jan.	2⅜	.....
Federal M.&S.	New York	24¼	Dec. 29	5⅛	Apr. 21	24	25,200
Fed.M.&S.pfd.	New York	64¼	Dec. 26	41⅛	Jan. 2	61⅛	145,100
Florence Silver	Spokane	*24	Feb.	*2½	Oct.	*5⅜	.....
Hecla Mining	N.Y. Curb	13⅛	Dec.	8⅛	April	12¾	71,900
Iron Blossom	N.Y. Curb	*37	Dec.	*20	July	*26	67,000
Marsh Mines	N.Y. Curb	*13	Jan.	*4	Dec.	*6	53,200
Park City	Salt Lake	5	Jan.	3½	July	5	.....
Park Utah	Salt Lake	5	Feb.	2½	July	3⅛	.....
Prince Con.	Salt Lake	*19	Dec.	*3½	May	*19	.....
SilverKingCoa.	Salt Lake	5.95	Dec.	3½	Jan.	5.95	.....
Simon S.-L.	N.Y. Curb	*2	Jan.	*1	Jan.	*1	28,800
Silversmith	Spokane	*46½	May	*25	Oct.	*27½	.....
Tamarack-Cus.	Spokane	2.04	March	*95	Dec.	*97	.....
Tintic Std.	Salt Lake	9.50	Dec.	3.75	Jan.	8.50	.....
Utah Apex	Boston	3⅛	Dec. 31	1⅞	June 26	3⅞	84,809
VANADIUM							
Vanadium. Corp.	New York.	33½	Feb. 11	19⅛	June 9	29⅜	426,600
ARSENIC							
West.UtahCop.	N.Y. Curb.	*40	Jan.	*15	Aug.	*15	222,000
ASBESTOS							
Asbestos Corp.	Montreal	38½	Dec.	19	June	35½	.....
Asbestos pfd.	Montreal	74	Dec.	52	May	73½	.....
SULPHUR							
Freeport Texas.	New York.	13⅞	Jan. 7	7½	Sept. 6	10¼	235,100
Texas Gulf	New York.	110	Dec. 27	57¼	Apr. 21	108	818,800

Company	Exch.	High		Low		Last	Sale
PLATINUM							
So. Am. G. & P.	N.Y. Curb.	5⅛	Oct.	2⅞	Jan.	3½	124,380
DIAMONDS							
DeBeers Con.	New York.	22¼	Dec. 5	18¼	Jan. 21	22⅛	13,900
MINING, SMELTING, AND REFINING							
Amer. Metal	New York.	54	Dec. 30	38¾	June 3	53½	214,500
Am. Met. pfd.	New York	115½	Dec. 29	107¼	Apr. 30	115½	4,000
Amer. S. & Ref.	New York.	100⅞	Dec. 26	57½	Jan. 14	97⅞	1,316,950
A. S. & R. pfd.	New York.	107⅜	Dec. 26	96	Jan. 2	106½	51,629
Consol. M. & S.	Montreal	49⅞	Dec.	30	Jan.	49¾	.....
Federated Met.	N.Y. Curb.	38¼	Dec.	30	Oct.	37	38,550
South'w. Met.	N.Y. Curb.	2	Dec.	*50	.....	2	1,100
U.S. Sm.R.&M.	New York.	41½	Dec. 27	18½	Mar. 26	38½	240,900
U.S.S. R.&M Pfd.	New York.	46⅞	Dec. 30	37½	Mar. 22	46½	23,700
IRON							
Beth. Steel	New York.	62½	Feb. 5	37¾	Oct. 22	50½	2,203,200
Charcoal Iron	Detroit	1½	Jan.	*15	Dec.	*15	.....
Charcoal I. pfd.	Detroit	2½	Jan.	*50	Sept.	*69	.....
Colo. F.& Iron.	New York.	54⅛	Aug. 5	24½	Jan. 4	43	2,557,100
Colo. F.&I. pfd.	New York.	108½	Sept. 4	108½	Sept. 4	108½	117
Gt. Nor. I. Ore.	New York.	39⅜	Nov. 25	26	May 23	36	509,800
Inland Steel	New York.	48¼	Nov. 28	31½	May 16	47	195,400
Inland S. pfd.	New York.	107⅞	Dec. 9	101½	Jan. 11	107	14,900
Mesabi Iron	N.Y. Curb.	8½	Jan.	2	May	3½	133,400
Replogle Steel.	New York.	23½	Nov. 29	7¼	June 11	21	952,800
Republic I. & S.	New York.	63⅜	Dec. 29	42	June 7	61½	727,100
Rep. I.&S. pfd.	New York.	95	Mar. 6	82	June 16	93½	31,950
Sloss-Sheffield.	New York.	84⅞	Dec. 19	52	May 20	82	249,700
Sloss-Shef. pfd.	New York.	96	Dec. 12	80	Apr. 11	95	9,129
U.S. Steel	New York.	121	Dec. 29	94¼	June 6	119¾	9,706,700
U.S. Steel, pfd.	New York.	123	July 23	118¾	Feb. 1	122⅛	132,510
Va. Iron C.&C.	New York.	53	Jan. 14	35	Oct. 27	41½	13,510
Va.I.C.&C.pfd.	New York.	80	Dec. 23	71	June 27	79	3,040

*Cents per share.

Mining Directory

Professional Organizations

American Institute of Mining and Metallurgical Engineers, 29 West 39th St., New York.
Mining and Metallurgical Society of America, 2 Rector St., New York.
Society of Economic Geologists, 42 Broadway, New York.
Geological Society of America, Museum of Natural History, Columbus Ave. and 77th St., New York.
Geological Society of Washington, U. S. Geological Survey, Washington, D. C.
American Electrochemical Society, Columbia University, New York.
American Chemical Society, 1709 G St., N. W., Washington, D. C.
Institution of Mining and Metallurgy, 225 City Road, London E. C. 1, England.
Society of Chemical Industry, Central House, Finsbury Square, London, E. C. 2, England; Pratt Institute, Brooklyn, New York.
Geological Society of London, Burlington House, London W., England.
Canadian Institute of Mining and Metallurgy, Drummond Building, Montreal, Quebec, Canada.
Australasian Institute of Mining and Metallurgy, 48 Queen St., Melbourne, Victoria, Australia.
Chemical, Metallurgical and Mining Society of South Africa, 100 Fox St., Johannesburg, Transvaal, South Africa.

Mining and Allied Educational Institutions

United States

Alabama—Mine Experiment Station, University of Alabama, University, Ala.; Dr. H. D. Pallister, Director.
Alaska—Alaska Agricultural College and School of Mines, Fairbanks, Alaska; Charles E. Bunnell, President.
Arizona—College of Mines and Engineering, University of Arizona, Tucson, Ariz.; Dr. G. M. Butler, Dean.
Arkanas—Department of Geology, University of Arkansas, Fayetteville, Ark.; Gilbert H. Cady, Head.
California—College of Mining, University of California, Berkeley, Calif.; Frank H. Probert, Dean.
Department of Mining and Metallurgy, Stanford University, Calif.; Theodore J. Hoover, Dean.
Colorado—Colorado School of Mines, Golden, Colo.; Victor C. Alderson, President.
Connecticut—Department of Mines and Metallurgy, Sheffield Scientific School, Yale University, New Haven, Conn.; C. H. Mathewson, Professor of Metallurgy, and R. Britton Gottsberger, Professor of Mining.
Idaho—School of Mines, University of Idaho, Moscow, Idaho; Francis A. Thomson, Dean.
Illinois—Mining Engineering Department, University of Illinois, Urbana, Ill.; A. C. Callen, Head.
Iowa—Mining Engineering Department, Iowa State College, Ames, Iowa; Prof. A. K. Friedrich, Head.
Kansas—Department of Mining Engineering, University of Kansas, Lawrence, Kan.; Prof. C. M. Young, Head.
Kentucky—Department of Mines and Metallurgy, University of Kentucky, Lexington, Ky.; C. J. Norwood, Head and Professor of Mining.
Massachusetts—Department of Mining, Metallurgy and Geology, Massachusetts Institute of Technology, Cambridge, Mass.; Prof. Waldemar Lindgren, Head.
Michigan—Michigan College of Mines, Houghton, Mich.; C. M. Carson, Acting President.
Minnesota—School of Mines, University of Minnesota, Minneapolis, Minn.; W. R. Appleby, Dean.
Missouri—Missouri School of Mines and Metallurgy, Rolla, Mo.; Dr. Charles H. Fulton, Director.
Montana—Department of Geology, University of Montana, Missoula, Mont.; Prof. J. P. Rowe, Head; C. H. Clapp, Professor of Geology.
Montana State School of Mines, Butte, Mont.; G. W. Craven, President.
Nevada—Mackay School of Mines, University of Nevada, Reno, Nev.; John A. Fulton, Director.
Virginia City School of Mines, Virginia City, Nev.; A. E. MacArthur, Director.
New Mexico—New Mexico School of Mines, Socorro, N. M.; E. H. Wells, President.
New York—School of Mines, Columbia University, New York, N. Y.; Arthur F. Taggart, Executive Officer.
Department of Geology, Cornell University, Ithaca, N. Y.; Prof. H. Ries, Head.
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Oklahoma School of Mines and Metallurgy, Wilberton, Okla.; E. E. Tourtellotte, President.
Oregon—School of Mines, Oregon Agricultural College, Corvallis, Ore.; Charles E. Newton, Dean.
Pennsylvania—Department of Mining and Metallurgy, Carnegie Institute of Technology, Schenley Park, Pittsburgh, Pa.; Prof. Fred Crabtree, Head. Department of Mining Engineering, Lehigh University, Bethlehem, Pa.; Prof. Howard Eckfeldt, Head. Department of Mining Engineering, Lafayette College, Easton, Pa.; W. B. Plank, Head. School of Mines, University of Pittsburgh, Pa.; F. L. Bishop, Dean. School of Mines, Pennsylvania State College, State College, Pa.; E. A. Holbrook, Dean.
South Dakota—South Dakota State School of Mines, Rapid City, S. D.; C. C. O'Harra, President.
Texas—College of Mines and Metallurgy, University of Texas, Austin, Tex.; John W. Kidd, Dean.
Utah—Schools of Mines and Engineering, University of Utah, Salt Lake City, Utah; Dr. Joseph F. Merrill, Director.
Virginia—Department of Mining Engineering, Virginia Polytechnic Institute, Blacksburg, Va.; Prof. O. C. Burkhart, Head.
Washington—College of Mines, University of Washington, Seattle, Wash.; Milnor Roberts, Dean. School of Mines and Geology, State College of Washington, Pullman, Wash.; L. O. Howard, Dean.
West Virginia—Department of Mining Engineering, West Virginia University, Morgantown, W. Va.; Prof. C. E. Lawall, Acting Head.

Mining and Allied Educational Institutions (Continued)

Wisconsin—Department of Mining and Metallurgy, University of Wisconsin, Madison, Wis.; Prof. R. S. McCaffery, Chairman. Wisconsin Mining School, Platteville, Wis.; H. B. Morrow, Director.
Wyoming—Department of Mining Engineering, University of Wyoming, Laramie, Wyo.; Prof. E. Prosper McCarty, Head.

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University of Toronto, Queen's Park, Toronto, Ont.
Queen's University, Kingston, Ont.
McGill University, Montreal, Que.
University of Alberta, Edmonton, Alberta.
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Mexico

Escuelas de Ingenieros, Mérida, Yucatan.
Escuelas de Ingenieros, Morélia, Michoacan.
Escuela Nacional de Maestros, Zacatecas, Zacatecas.
Colegio de Estato, Guanajuato, Guanajuato.
Ingenieros Agrónimos, Leon, Guanajuato.
Instituto Juarez, Villahermosa, Tabasco.
Universidad Nacional de Mexico, Mexico, D. F.
Instituto Geológico, Mexico, D. F.

U. S. Bureau of Mines

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Pittsburgh, Pa.—Superintendent Pittsburgh Experiment Station, Arno C. Fieldner; Chief Engineer, Division of Mine Safety Service, D. J. Parker; Chief Coal Mining Engineer, James W. Paul.

U. S. Geological Survey

Director, George Otis Smith.
Chief Clerk, H. C. Rizer.
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Alaskan Mineral Resources Branch, —— ——.
Topographic Branch, C. H. Birdseye.
Water-Resources Branch, N. C. Grover.
Land-Classification Branch, Herman Stabler.
Publication Branch, Editor, G. M. Wood.
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Colorado—Prof. Russell D. George, State Geologist, University of Colorado, Boulder, Colo.
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Georgia—Prof. S. W. McCallie, State Geologist, Geological Survey of Georgia, Atlanta, Ga.
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Missouri—H. A. Buehler, State Geologist and Director, Bureau of Geology and Mines, Rolla, Mo.
Montana—George W. Craven, Director, State Bureau of Mines and Metallurgy, Butte, Mont.; Dr. C. H. Clapp, President, University of Montana, Missoula, Mont.
Nebraska—Prof. E. H. Barbour, State Geologist, University of Nebraska, Lincoln, Neb.
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New Jersey—Dr. H. B. Kummell, Director and State Geologist, Department of Conservation and Development, Trenton, N. J.
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New York—Dr. John M. Clarke, State Geologist, University of the State of New York, Albany, N. Y.
North Carolina—Brent S. Drane, Director, North Carolina Geological and Economic Survey, P. O. Box 406, Raleigh, N. C.
North Dakota—Dr. A. G. Leonard, State Geologist, State Geological Survey, University of North Dakota, University, N. D.
Ohio—Prof. J. A. Bownocker, State Geologist, Geological Survey of Ohio, Columbus, Ohio.
Oklahoma—Charles N. Gould, Director, Oklahoma Geological Survey, Norman, Okla.
Oregon—Henry M. Parks, Consulting Geologist, 821 Spalding Building, Portland, Ore.
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South Carolina—Prof. Stephen Taber, State Geologist, Columbia, S. C.
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Utah—Prof. William Peterson, State Geologist, Agricultural College of Utah, Logan, Utah.
Vermont—Dr. George H. Perkins, State Geologist, Dean, University of Vermont, Burlington, Vt.
Virginia—Dr. Thomas L. Watson, Director and State Geologist, Virginia Geological Survey, Charlottesville, Va.
Washington—Prof. Solon Shedd, Supervisor of Geology, Department of Conservation and Development, Pullman, Wash.
West Virginia—Dr. I. C. White, State Geologist, West Virginia Geological Survey, Morgantown, W. Va.
Wisconsin—Dr. W. O. Hotchkiss, Director, Geological and Natural History Survey, Madison, Wis.
Wyoming—A. B. Bartlett, State Geologist, Geological Survey of Wyoming, Cheyenne, Wyo.
Ontario, Canada—Willet G. Miller, Provincial Geologist, Toronto, Ont., Canada.

Trade Associations

General—American Bureau of Metal Statistics, 115 Broadway, New York; American Mining Congress, 841 Munsey Building, Washington, D. C.; Association of Arizona Mining Men, Phoenix, Ariz.; California Metal and Mineral Producers' Association, San Francisco; Chamber of Commerce and Mines, Douglas, Ariz.; Chamber of Mines and Oil, Los Angeles, Calif.; Idaho Mining Association, Mackay, Idaho; Montana Mining Men's Association, Helena, Mont.; National Metal Trades Association, Chicago, Ill.; Nevada Mine Operators' Association, Reno, Nev.; Northwest Mining Association, Spokane, Wash.
Copper—Copper and Brass Research Association, 25 Broadway, New York; Copper Export Association, 25 Broadway, New York.
Gold—American Gold and Silver Institute, Washington, D. C.
Graphite—Plumbago-Graphite Association, 17 State St., New York.
Gypsum—Gypsum Industries Association, 111 W. Washington St., Chicago.
Iron and Steel—American Iron and Steel Institute, 40 Rector St., New York; American Pig Iron Association, Penton Building, Cleveland, Ohio; Association of American Steel Manufacturers, Pittsburgh, Pa.; Lake Superior Iron Ore Association, Cleveland, Ohio.
Kaolin—Southern Kaolin Miners' Association, Macon, Ga.
Lead—American Institute of Lead Manufacturers, 90 West St., New York.
Limestone, Lime—Indiana Limestone Quarrymen's Association; National Agricultural Limestone Association, Columbus, Ohio; National Lime Association, 980 G Street N.W., Washington, D. C.
Magnesia—Magnesia Association of America, 246 N. 17th St., Philadelphia, Pa.
Magnesite—Western Magnesite Association, San Francisco.
Petroleum—American Petroleum Institute, 17 West 44th St., New York.
Phosphate Rock—Phosphate Export Association, 2 Rector St., New York.
Portland Cement—Portland Cement Association, 347 Madison Ave., New York.
Potash—U. S. Potash Producers' Association, Southern Building, Washington, D. C.
Refractories—Refractories Manufacturers' Association, 840 Oliver Building, Pittsburgh, Pa.
Sand and Gravel—National Sand and Gravel Association, Washington, D. C.
Slate—National Slate Association, Philadelphia, Pa.
Talc—Talc and Soapstone Producers' Association, Box 557, Cleveland, Tenn.
Zinc—American Zinc Institute, 27 Cedar St., New York.

The Market Report

Daily Prices of Metals

Jan.	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
8	14.75	58.875	59.50	10.30	10.15	7.775
9	14.75@14.875	59.00	59.625	10.325	10.175	7.80@7.85
10	14.875	58.875	59.50	10.35	10.20	7.85
12	14.875	58.75	59.375	10.50	10.375	7.85@7.875
13	14.875	58.125	58.75	10.525	10.375	7.85@7.875
14	14.875	57.875	58.50	10.55	10.375	7.875
Av.	14.844	58.583	59.208	10.425	10.275	7.842

*These prices correspond to the following quotations for copper delivered: Jan. 8th, 15c.; 9th, 15@15.125c.; 10th to 14th inc., 15.125c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
8	66¼	67⅜	70½	270⅜	274¼	42⅝	40½	38	37⅝
9	66¾	67⅞	70¾	270½	274¾	42¾	40⅞	38 5/16	37 15/16
12	67¼	68⅜	71½	270	274	43⅜	41½	38 5/16	38 1/16
13	66¾	67⅞	71½	266¾	271	43½	41½	38 11/16	38 3/16
14	66¾	67⅞	71½	265¾	269¾	43⅛	41¼	38¾	38¼

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver		Gold London	Jan.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
8	4 76½	67⅞	32	87s 4d	12	4.78⅛	69⅜	32 9/16	86s11d
9	4.78½	68½	32 3/16	87s 2d	13	4.76¾	68¾	32⅜	87s 1d
10	4 78½	68¾	32 5/16	.....	14	4.76¾	68½	32¼	87s 8d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Prices Advance Again in Quiet Market

New York, Jan. 14, 1925—Sales of only moderate volume have taken place in the non-ferrous metal markets during the last week, but prices have advanced further, owing to higher levels in Europe and to the fact that American producers are, in general, well sold up.

Copper Sellers Asking 15⅛c.

A slight reaction occurred in the copper market last Thursday and Friday, when some sellers anxious to dispose of the metal were unable to get more than 15c. delivered. Since then, practically all interests have asked 15⅛c. for Eastern deliveries and have sold moderate tonnages at that level. For Rome and Middle Western points, 15⅛c. is the general level. At these prices, producers are willing to sell for January, February, or March, but have been compelled in some instances to include April shipment also, in order to make sales. Foreign sales have been relatively better than domestic, most of the business in the last two or three days being booked at 15.25@15.30c., c.i.f.

Lead Prices Jump Twice

The contract price for New York lead, set by the American Smelting & Refining Co., was advanced from 10 to 10.25c. on Thursday, Jan. 8, and to 10.50c. on Monday, Jan. 12. Other sellers made corresponding advances, but consumers are showing more of a disinclination to pay premium prices, and sales above 10¼c., New York, have been small. The present price is almost if not quite high enough to permit lead smelted in this country from foreign ore to be sold in the domestic market for future delivery. In the Coeur d'Alenes, a decided increase in production is announced to take effect immediately, and miners and smelters in other parts of the country are also feeling the stimulus of 10c. lead. Wages have been increased 10 per cent by the largest operating company in Southeast Missouri. In the St. Louis market, one producer is selling limited tonnages at 10¼c., with other sales around 10½c.

Zinc Strongly Held

The leading producers are holding zinc firmly at advancing prices, which are really set by export parity. Zinc offered by small producers is quickly bought up. Prompt zinc is scarce, and slightly lower prices are named for forward deliveries than for spot. In Europe the principal demand is for April and later, indicating a marked confidence in the market. Stock, Dec. 1, 26,912 tons; produced, 47,711; shipped, 53,415; stock, Dec. 31, 21,208; shipped for export, 10,907. Total retort capacity, 145,480; available, 140,467; operating in December, 81,008; operating end of December, 81,274. Zinc produced in 1924, 535,846 tons; shipped, 551,216; shipped for export, 78,872.

Tin Fairly Active

Slight recessions in price have tempted buyers in the last two days, fairly good tonnages being sold at 58½@59c. for spot, with premiums of ⅛ to ¼c. asked for forward.

Silver Lower

The advance in silver continued until Jan. 12, when the peak on this movement was reached in both New York and London. Since that date a reaction has occurred, brought about by China sales.

Mexican Dollars: Jan. 8th, 52½c.; 9th, 52⅜c.; 10th, 52⅞c.; 12th, 53⅛c.; 13th, 52⅞c.; 14th, 52⅜c.

Exchanges React Downward

Closing cable quotations on Tuesday, Jan. 13, were: francs, 5.345c.; lire, 4.16c.; and marks, 23.81c. Canadian dollars, 11/32 per cent discount.

Latest Price Changes

Arsenious Oxide (white arsenic)—5¾@6c. per lb.

Ferromanganese—Domestic, German, and English, $115 per gross ton, f.o.b. works, or duty paid at seaport.

Rolled Copper—Sheets, 23c.; wire, 17¼c.

Lead Sheets—Full lead sheets, 14c. per lb.; cut lead sheets, 14¼c. in quantity, mill lots.

Nickel Silver—29½c. per lb. for 18 per cent nickel Grade A sheets.

Yellow Metal—Dimension sheets, 20⅝c. per lb.; rods, 17⅝c. per lb.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 27c. London, £125.

Antimony—Per lb.:
Chinese brands, 17½c.
Cookson's "C" grade, 19½c.
Chinese needle, lump, nominal, 10c.
Standard powdered needle, 200 mesh, 11½@13c.

White oxide, Chinese, 99 per cent Sb_2O_3, 14¾@16c.

Bismuth—$1.25@$1.30 per lb. London, 5s.

Cadmium—60c. per lb. London, 2s. 2d.@2s. 6d.

Iridium—$325 per oz.

Nickel—Ingot, 31c.; shot, 32c.; electrolytic, 38c.; London, £162½ per long ton.

Palladium—$79@$83 per oz. Crude, $60@$65.

Platinum—$117 per oz. for refined. Crude, $111.

Quicksilver—$81@$83 per 75-lb. flask. San Francisco wires $81.65. Quiet. London, £13¾.

The prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmiridium, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and **Zirconium** are unchanged from the prices given in the Jan. 3 issue.

Metallic Ores

Tungsten Ore—Per unit, N. Y.:
Chinese wolframite, $9.
High-grade Western scheelite, $9.50.

Chrome, Iron Ore, Galena Radio Crystals, Manganese, Molybdenum, Tantalum, and **Vanadium Ores** are unchanged from Jan. 3 quotations.

Prices of other raw and finished products unchanged from Jan. 10 issue.

Zinc Ore Firm—Lead Ore Again Advances

Joplin, Mo., Jan. 10, 1925

Blende	Per Ton
High	$62.50
Premium, basis 60 per cent zinc	$59.00@$60.00
Prime Western 60 per cent zinc	$57.50@$58.00
Fines and slimes	$57.00@$55.00
Average settling price, all	$52.37
Lead	
High	$141.10
Basis 80 per cent	$145.00
Average settling price, all	$136.30

Shipments for the week: Blende, 16,977; lead, 1,939 tons. Value, all ores the week, $1,153,350.

Weather conditions sufficiently improved to permit a production of 15,000 tons this week, and it is thought another week will produce enough ore to fill all advance sales made last month. Stock is reduced to the lowest point for several years.

Last year the average shipment for the entire year was 14,330 tons per week. With no greater demand this year a production of 15,000 tons will slightly swell reserve stock each week.

Lead ore prices are in a measure indefinite, rumors being current of $147.50 to $150 basis being granted some sellers. Lacking confirmation, this price is not quoted above.

Platteville, Wis., Jan. 10, 1925

Zinc	Per ton
Blende, basis 60 per cent zinc	$60.50
Lead	
Lead, basis 80 per cent lead	$142.50

Shipments for the week: Blende, 835 tons; lead, 80 tons. Shipments for the year: Blende, 835; lead, 80 tons. Shipments for the week to separating plants, 1,354 tons blende.

Iron Quiet But Firm

Pittsburgh, Jan. 13, 1925

Pig Iron—Market quiet, but with the price situation very firm. Recent transactions have been at $22.50 for bessemer, $21.50 for basic, and $22 for foundry, f.o.b. Valley furnaces, but producers count on 50c. advance as soon as any demand develops, and are referring to the prospect of Lake Superior iron ore advancing for the coming season.

Connellsville Coke—The market has weakened, largely from dissatisfaction of consumers with recent advances. Spot furnace is off 25c. to $4@$4.25. Contract asking prices of $5 for first and $6 for second quarter are not seriously regarded and a little business has been done at considerably less. Spot foundry remains quotable at $5@$5.50, but is in light demand and the average of sales is much nearer $5 than $5.50.

Joplin Zinc and Lead Ore Statistics

Blende, Comparison of 1924 with 1923, in Tons

	Production	Purchase	Shipment	Stock End of Year
1924	706,550	659,520	733,340	26,200
1923	672,570	630,140	688,020	52,990
Increase	33,880	29,380	45,320	
Decrease				26,790

Shipments,	1923	733,340
Production,	1924	706,550
Decrease in stock		26,790

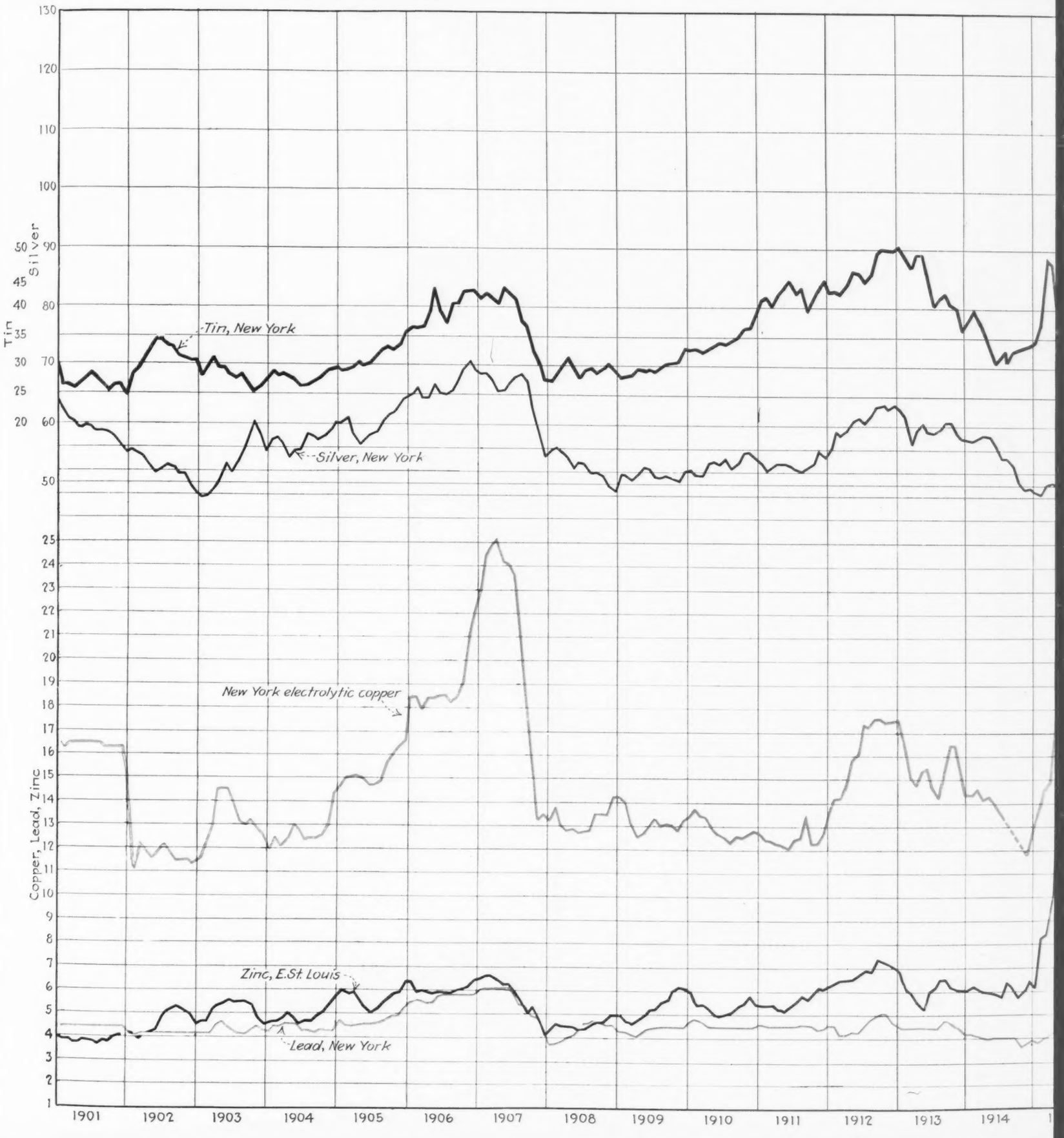
Ore Prices	Blende Premium	Prime Western	Fines and Slimes	Zinc Dec. Av.
End of 1924	$58.00 @ $60.00	$55.00 @ $57.00	$54.00 @ $49.00	7.374
End of 1923	42.00	41.00	40.00 @ 38.00	6.260

Blende, Basis 60% Zinc, 1924

		Blende Premium	Prime Western	Fines and Slimes	Lead, Basis 80 Per Cent
Jan.	5	$44	$42.50@$43	$41@$39	$107.50
	12	44	43	42@ 40	110
	19	44 @$45	43 @ 44	42@ 40.50	110 @$115
	26	45 @ 46	44 @ 44.50	43@ 40	115 @ 116
Feb.	2	45 @ 46	44 @ 44.50	43@ 41	117.50
	9	45 @ 46	44	43@ 41	118.50@ 120
	16	46 @ 47	44 @ 45	43@ 41	121
	23	46 @ 47	45	44@ 41.50	121 @ 122.50
Mar.	1	46	43	42@ 40	125
	8	44 @ 43	42 @ 41	40@ 37	125
	15	42	41 @ 40	39@ 37	125 @ 120
	22	43	41	40@ 37	115
	29	42 @ 41	40 @ 39.50	39@ 38	110
Apr.	5	42	40	39@ 37	105
	12	40	40 @ 39	38@ 37	95
	19	39	38	37@ 36	95
	26	40	39 @ 40	38@ 36	90
May	3	39	38 @ 39	37@ 35.50	90
	10	40	39	38@ 36	50
	17	40	39	38@ 36	80
	24	40	39 @ 38	38@ 36	77.50
	31	40	39	38@ 36	77.50
June	7	40 @ 41	39 @ 40	38@ 36	77.50@ 80
	14	40 @ 41	39 @ 40	38@ 36	80
	21	40 @ 41	39 @ 40	38@ 36	80
	28	40 @ 41	39 @ 40	38@ 36	80
July	5	41	40	39@ 37.50	80
	12	41	40	39@ 37	80
	19	41 @ 40	40 @ 39.50	39@ 37	80
	26	41 @ 42	40 @ 41	39@ 37	85 @ 90
Aug.	2	42	40 @ 41	39@ 36.50	90
	9	42 @ 43.50	41 @ 42	40@ 38	100
	16	43 @ 43.50	43 @ 42.50	41@ 38	105 @ 110
	23	44	43.50@ 43	42@ 39	110
	30	44	43 @ 43.50	42@ 40	110
Sept.	6	44	43.50	42@ 40	110
	13	44	43	42@ 40	110 @ 107.50
	20	43	42	41@ 40	107.50
	27	42	41	40@ 38	107.50
Oct.	4	42 @ 42.50	41	40@ 38	107.50
	11	42.50@ 43	41 @ 42	40@ 38	107.50@ 110
	18	43 @ 44	42 @ 43	41@ 38	110 @ 115
	25	44.50@ 45.50	43 @ 45	42@ 40	115 @ 117.50
Nov.	1	45.50@ 46	44 @ 44.50	43@ 41	120
	8	46 @ 47	45 @ 45.50	44@ 42	120
	15	47 @ 48	46 @ 47	44@ 42	120
	22	46 @ 47	45	44@ 41	120
	29	48 @ 49	47	46@ 42	120
Dec.	6	48 @ 49	47	46@ 43	122
	13	51 @ 52	50	49@ 44.50	125
	20	55 @ 56	52 @ 54	51@ 49	130
	27	58 @ 60	55 @ 57	54@ 49	135

Average settlement price all blende, $42 per ton.
Average settlement price, all lead, $107.24 per ton.
Calamine—1,560 tons sold at an average settlement price of $34.31 per ton.

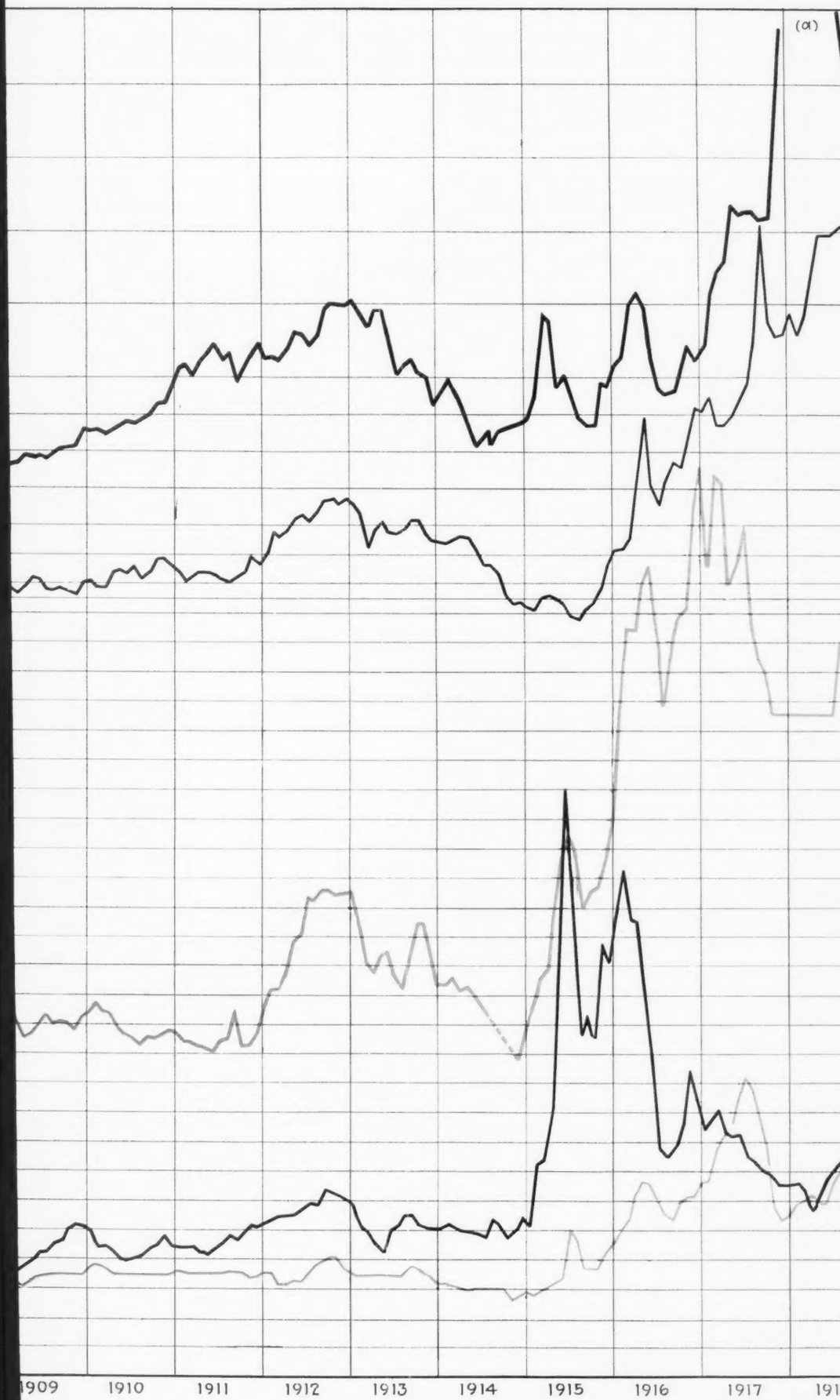
Metal Price Chart of the Engineering and Minin



(a) No Engineering and Mining Journal quotations for this period

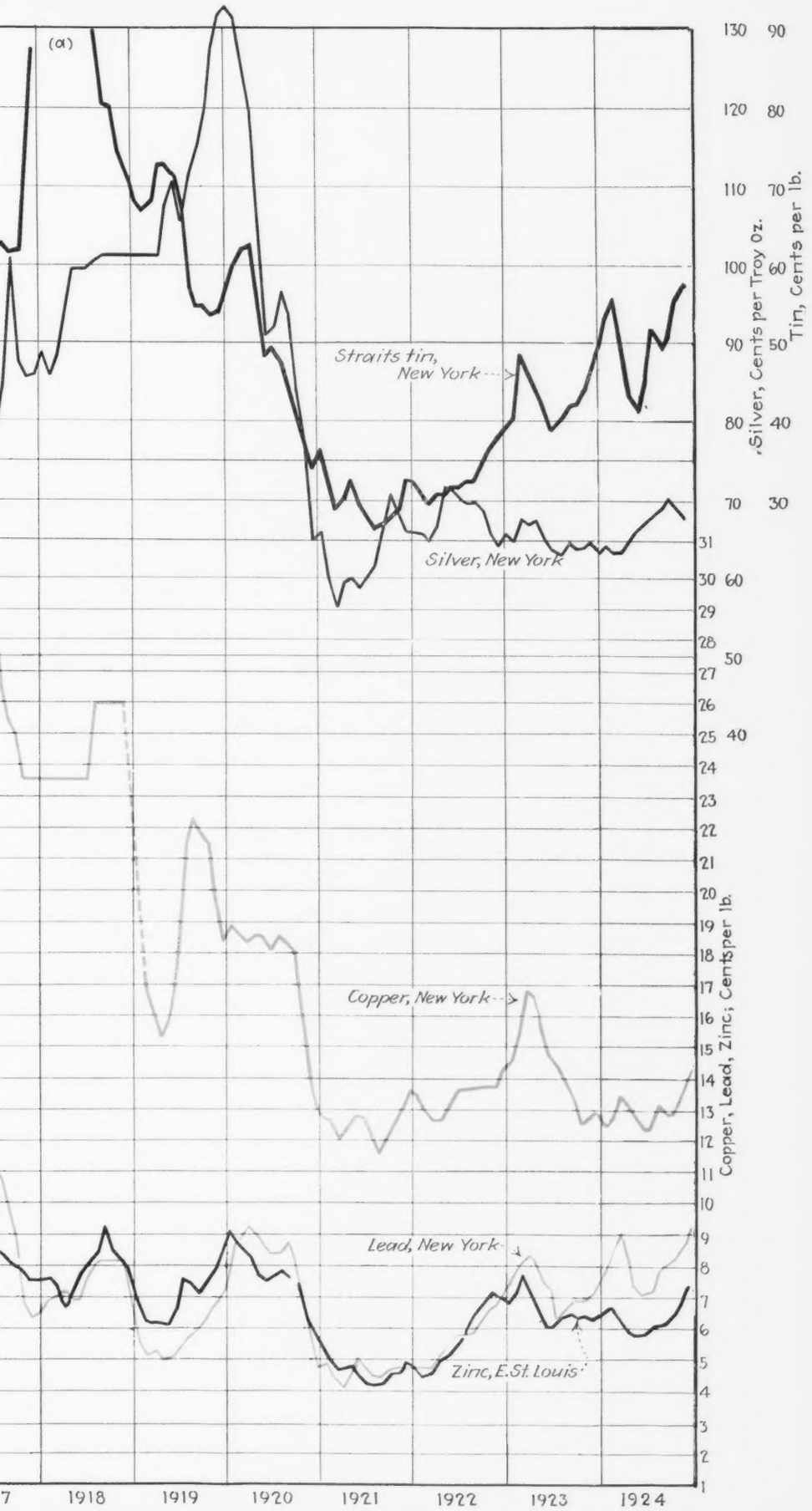
Prices of Copper, Lead, Zinc, Ti

f the Engineering and Mining Journal-Press



es of Copper, Lead, Zinc, Tin, and Silver

Press, 1901-1924



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